

DV-MUX3

ADAPTIVE MULTIPLEXER FOR VOICE, FAX AND DATA

Installation and Operation Manual

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Safety Warnings



The exclamation point within a triangle is intended to warn the operator or service personnel of operation and maintenance factors relating to the product and its operating environment which could pose a safety hazard.

Always observe standard safety precautions during installation, operation and maintenance of this product. Only a qualified and authorized service personnel should carry out adjustment, maintenance or repairs to this instrument. No adjustment, maintenance or repairs should be performed by either the operator or the user.

Telecommunication Safety

The safety status of each of these ports on the DV-MUX3 is declared according to EN 41003 and is detailed in the table below:

Safety Status	Ports
SELV	V.24, V.35, V.36, X.21, 530
TNV	FXO, FXS, E&M

SELV = Safety Extra-Low Voltage
TNV = Telecommunications Network



In order to ensure the safety of the operator, the DV-MUX3 must be connected to a reliable protective earth and the signal ground must be connected to the chassis ground at all times.

Additional conditions concerning safety:

- The FXO interface is suitable for direct connection to the PSTN, and does not rely on the protective earth for safety. However, a mixed combination (e.g. FXO and E&M together) *does* rely on the protective earth for safety.
- The FXS interface is intended for connection of a telephone set or similar equipment and is *not* intended for a direct connection to the PSTN.
- The E&M interface is intended for direct connection to a PABX approved to EN60950 and EN41003, but is *not* intended for direct connection to the PSTN

Regulatory Information

FCC-15 User Information

This equipment has been tested and found to comply with the limits of the Class A digital device, pursuant to Part 15 of the FCC rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to the radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

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Declaration of Conformity

Manufacturer's Name: RAD Data Communications Ltd.

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declares that the product:

Product Name: DV-MUX3

Conforms to the following standard(s) or other normative document(s):

EMC:	EN 55022 (1994)	Limits and methods of measurement of radio disturbance characteristics of information technology equipment.
	EN 50082-1 (1992)	Electromagnetic compatibility - Generic immunity standards for residential, commercial and light industry.
Safety:	EN 60950 (1992/93)	Safety of information technology equipment, including electrical business equipment.

Supplementary Information:

The product herewith complies with the requirements of the EMC Directive 89/336/EEC and the Low Voltage Directive 73/23/EEC. The product was tested in a typical configuration.

Tel Aviv, November 17th, 1996



Haim Karshen
VP Quality

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CHAPTER 1.

INTRODUCTION

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1-1. FUNCTIONAL DESCRIPTION

Purpose and Main Features

The DV-MUX3 is a versatile adaptive time division multiplexer (TDM) for voice, fax, and data. The DV-MUX3 allows the multiplexing of one or two low bit rate voice/fax channels with one synchronous data channel, for transmission through a dial-up or leased-line modem link operating at rates in the range of 9.6 through 256 kbps. Asynchronous data can also be transmitted by using asynchronous-to-synchronous converters, or by oversampling (for oversampling, the asynchronous data rate must not exceed 1/4 of the synchronous channel rate).

Bandwidth efficiency is obtained by very low multiplexing and link supervision overhead. In addition, the DV-MUX3 offers three user-selectable multiplexing modes that allow maximization of the bandwidth efficiency while taking into account the characteristics of the user equipment:

- Maximal bandwidth efficiency is achieved in the proprietary adaptive mode. In this mode, the DV-MUX3 dynamically reassigns the link bandwidth used by the voice channels to the data channel when both voice channels are idle. In this mode, the data channel can serve statistical multiplexers, remote bridges, and other equipment that tolerates changes in the link data rate.
- The other two multiplexing modes, intended for use with equipment that is not capable of handling the varying clock rate of the adaptive mode, are standard (non-adaptive) modes that support predetermined channel data rates (see para. 1-2). The non-adaptive modes differ only in the supported data rates:
 - One non-adaptive mode supports the standard data rates (based on the $n \times 75$ bps scheme). In this mode, the data channel can serve all types of data terminal equipment.

- The other non-adaptive mode provides the user with access to all the link bandwidth that is not used by the voice channel. In this mode, the data channel can serve data terminal equipment capable of operation in accordance with the rate of the clock signals provided by the DV-MUX3, including operation at data rates which are not necessarily based on the $n \times 75$ bps scheme.

Thus, the DV-MUX3 allows using a single modem link for the transmission of two voice/fax channels, and in addition allows the transmission of a data channel.

The DV-MUX3, especially when operating in its unique adaptive multiplexing mode, offers very high bandwidth efficiency without introducing the long, variable link delay typical of statistical multiplexers.

Voice/Fax Channel Features

The DV-MUX3 can be ordered with one or two voice/fax channels. To reduce bandwidth requirements yet achieve high quality voice transmission, the voice channels process the audio signals using a standard digitizing algorithm (MPMLQ - Multipulse Maximum Likelihood Quantization per ITU-T Rec. G.723), and adaptive echo cancellation.

The bandwidth assigned for the transmission of a voice channel is user-selectable: 4.8, 6.4, 7.2, 9.6 or 12.8 kbps. This bandwidth includes in-band signaling and synchronization overhead. When operating at a digitized voice data rate of 6.4, 7.2, 9.6 or 12.8 kbps, the end-to-end voice performance is nearly toll quality. To improve the perceived link quality, the DV-MUX3 voice channel includes an adaptive echo canceler that handles near-end reflections (echo delay less than 8 milliseconds) such as reflections caused by the hybrids used for 2W/4W conversion. The echo canceler convergence time is better than ITU-T Rec. G.165 requirements.

To maintain voice quality on bad communication links, when operating at 7.2, 9.6 or 12.8 kbps the DV-MUX3 voice channels include Hamming forward error correction (FEC) coding that protects the critical information bits in the digitized voice data stream. The FEC code can maintain voice quality for link error rates down to 1×10^{-3} .

Each channel supports fax transmission for Group 3 fax machines in accordance with ITU-T Rec. T.4 and T.30 at rates of 2.4, 4.8, 7.2 or 9.6 kbps (according to voice channel rate). Each channel automatically identifies the type of signal (voice or fax) and switches accordingly between the voice and fax modes. Therefore, the user can follow the regular fax operating procedures.

Each voice channel has its own level adjustment switches, to provide optimal selection of receive and transmit levels.

The voice channels are available in three options:

- 2W FXO interface: two-wire 600-ohm analog interface and FXO loop-start signaling for direct connection to PABX extension lines.
- 2W FXS interface: two-wire 600-ohm analog interface and FXS loop start signaling for direct connection of a subscriber telephone set. The FXS interface generates locally the required line feed current and the ringing voltage.
- 2W/4W E&M interface: two-wire or four-wire analog interface and E&M signaling. This interface supports five types of E&M signaling: RS-464 types I, II, III and V, and British Telecom SSDC5 (except the signaling battery voltage is -24V, instead of -48V).

The FXO and FXS options are usually operated in a link, with the FXO interface at the PABX side, and the FXS interface on the subscriber's side. In addition, two FXS interfaces can also be operated in a link, to provide PLAR (Private Line with Auto-Ring) telephone service.

The E&M interface is usually used to connect trunk lines of two PABXs. In this case, two E&M interfaces are operated in a link. The E&M interface can be also used to connect the subscriber side to a PABX E&M trunk interface. In this case, the E&M interface is used on the PABX side and the FXS interface on the subscriber side. The interface option can be independently selected for each voice channel, and each channel has its own eight-pin RJ-45 connector.

Data Channel Features The DV-MUX3 data channel provides a synchronous channel. The electrical interface of the data channel is user-selectable (X.21, V.35, V.36/RS-449, RS-530, or RS-232). The data channel is terminated in a 15-pin D-type female connector, wired in accordance with ITU-T Rec. X.21. When a different interface is selected, an appropriate adapter cable (available from RAD) must be inserted between the DV-MUX3 and the cable connecting to the user's equipment.

The data channel can operate at rates of 0.8 to 252.8 kbps, depending on the selected mode, and the main link data rate. Note that when the RS-232 interface is selected, the maximum data rate is limited by the electrical characteristics of this interface, which usually cannot work above 64 kbps.

The data channel interface is configured as a DCE, that is, it provides timing signals to the user's equipment: the receive and transmit timing is derived from the main link clock.

The data channel is transparent to user's data. The control lines generated by the data channel interface are Carrier Detect (CD) and Clear to Send (CTS). For the RS-232 interface, the DSR line is also provided. Those lines are asserted when the DV-MUX3 is operating normally (i.e., when the configuration is valid, the DV-MUX3 is synchronized, and the channel is not being tested). For interfaces other than RS-232, the CD line can be externally connected to the DSR line to enable operation of terminal equipment that needs DSR in active, e.g., IBM equipment.

The channel interface does not include control lines for hardware flow control, therefore when the user's application requires flow control, the user's equipment must use software flow control.

Main Link Characteristics

The electrical interface of the main link is user-selectable (X.21, V.35, V.36/RS-449, RS-530, or RS-232). The main link is terminated in a 15-pin D-type female connector, wired in accordance with ITU-T Rec. X.21.

When a different interface is selected, an appropriate adapter cable (available from RAD) must be inserted between the DV-MUX3 and the cable connecting to the data communication equipment (e.g., the modem) serving the main link. Note that the main link interface can be selected independently of the data channel interface, therefore interface conversion is available on the data channel.

The DV-MUX3 can operate at main link rates of 9.6 to 256 kbps (or up to about 64 kbps, when the selected interface is RS-232). The interface is configured as a DTE, that is, it requires clock signals for both the receive and transmit paths from the equipment to which it is connected.

The following control lines are used on the main link interface:

- The RTS line, which is asserted as long as the DV-MUX3 is powered.
- The DTR and RI lines, used only in the dial-up mode.

Dial-up Mode

The dial-up mode allows the DV-MUX3 to operate over the Public Switched Telephone Network (PSTN), using dial-up modems to transmit the main link data over standard PSTN lines.

The dial-up mode is available only when the main link interface is V.35 or RS-232. In this mode, the DV-MUX3 asserts the DTR line of its main link interface when payload traffic (from the voice or data channels) must be transmitted. This causes the modem to dial a number preprogrammed by the user, and thus to set up a connection to the remote DV-MUX3. When the remote DV-MUX3 senses the assertion of the RI line in its main link interface (indication of incoming call provided by the dial-up modem), it synchronizes to the other DV-MUX3 and starts normal data transfer. When payload traffic stops, the DV-MUX3 switches its DTR line off, causing the modem to disconnect the link.

Bandwidth Allocation

Bandwidth allocation is based on the automatic identification of the main link clock rate. After successful identification of the main link rate, the DV-MUX3 assigns the bandwidth required by the voice channels (as selected by the user), and uses the remaining main link bandwidth (less the link management and supervision overhead) to transmit the data channel. The overhead is 0.8 kbps for main link data rates of 9.6 to 32 kbps, 1.6 kbps for data rates of 48 to 128 kbps, and 3.2 kbps for data rates higher than 128 kbps.

To maximize the throughput of the data channel beyond what is available with standard multiplexers, the DV-MUX3 has three user-selectable bandwidth allocation modes:

- **Adaptive mode:** the DV-MUX3 monitors the use of the voice channels and assigns the required bandwidth on demand. Therefore, when both voice channels are idle, their bandwidth is temporarily reassigned to the data channel. These changes are smoothly made without disrupting in any way the flow of traffic.

The state of the voice channels is determined by the channel control signal transmitted end-to-end:

- For a voice channel equipped with FXO interface, the channel control signal generated by the channel indicates the reception of ringing by that channel. The control signal received by that channel indicates the detection of a subscriber off-hook condition by the FXS interface of the voice channel located at the other end of the link (off-hook includes pulse dialing).
- For a voice channel equipped with FXS interface, the channel control signal generated by that channel indicates the detection of an off-hook condition (including pulse dialing). The control signal received by that channel indicates either the reception of ringing by the FXO interface of the voice channel located at the other end of the link (when the other end is equipped with an FXO interface), or the detection of a subscriber off-hook condition (when the other end is also equipped with an FXS interface), or the detection of the M signal from a remote E&M interface.

- For a voice channel equipped with E&M interface, the channel control signal generated by that channel indicates detection of an M signal. The control signal received by that channel (E signal) indicates the reception of subscriber off-hook at the remote FXS module or detection of the M signal at the remote E&M module.
- When the channel control signal at either end of the link is switched to the active state, the DV-MUX3 immediately assigns the required bandwidth to the voice channels, and reduces the clock rate supplied to the data channel. Note that the DV-MUX3 always assigns the full bandwidth needed by voice channels. Therefore, for DV-MUX3 models equipped with two voice channels, when both channels are enabled the DV-MUX3 assigns bandwidth for two channels even if only one channel is active.
- **Non-adaptive mode 1:** the bandwidth required for the voice channels (as selected by the user) is permanently assigned to these channels. The remaining bandwidth, less the management and synchronization overhead, is available to the data channel. This mode is mainly intended to allow the connection of equipment that is capable of operating at non-standard data rates but cannot tolerate the clock rate changes that occur routinely in the adaptive mode. Such equipment can then use the highest available data rate, and thus achieve the highest possible bandwidth efficiency.
- **Non-adaptive mode 2:** in this mode, the DV-MUX3 operates as a standard TDM multiplexer, i.e., the bandwidth required for the voice channels is permanently assigned to these channels, and the data channel data rate is a standard data rate (see Table 1-2) that can be transmitted within the remaining main link bandwidth. This mode reduces somewhat the bandwidth efficiency but allows the connection of data equipment designed for standard data rates to the data channel.

User's Interface

All the DV-MUX3 operating parameters can be selected by the user, by means of internal jumpers and switches.

Downloading

To minimize setup time and to prevent configuration errors, the DV-MUX3 has a master-slave configuration downloading facility. When this facility is used, all the critical configuration parameters selected on the DV-MUX3 defined as the master unit are downloaded through the main link to the slave DV-MUX3.

Configuration downloading is automatically performed when a link is established between two DV-MUX3 units. This arrangement ensures the two units will always use consistent configurations.

Diagnostics

The DV-MUX3 has comprehensive diagnostic capabilities, which include:

- Power-up self-test.
- Internal BERT (bit error rate testing) facility, allows rapid evaluation of transmission quality without requiring external test equipment.
- Tone injection allows evaluation of voice channel quality.
- Remote test loops activated by a front-panel switch.

- Front panel indicators show main link synchronization status, transmit and receive activity on any desired channel, and activation of a test loop. In addition, the front panel indicators also indicate failures in the power-up self-test, configuration errors, and fault conditions related to the main link clock signals.

General Features

The DV-MUX3 can be ordered for AC operation (100, 115, or 230 VAC) or for -48 VDC operation, and has very low power consumption. It is built into a compact case that can be placed on desktops or shelves. Optional rack mount adapter kits allow the installation of one or two units side-by-side, in a 19" rack. Unit height is only 1U (1.75 in.).

1-2. TYPICAL APPLICATIONS AND SYSTEM DESIGN CONSIDERATIONS

Typical Applications

This section provides examples of applications that use the specific capabilities of the DV-MUX3.

Typical DV-MUX3 Application in an SNA Link

Figure 1-1 shows a typical application for a DV-MUX3. This application shows how an organization can use the DV-MUX3 to connect privileged telephone subscribers located in another city, e.g., at a main branch office, to the PABX serving the head offices. This arrangement allows those remote subscribers to use all the features, speed, and convenience available to local subscribers of the main office PABX without the expense of leasing a dedicated voice line or allocating a full data channel for this purpose.

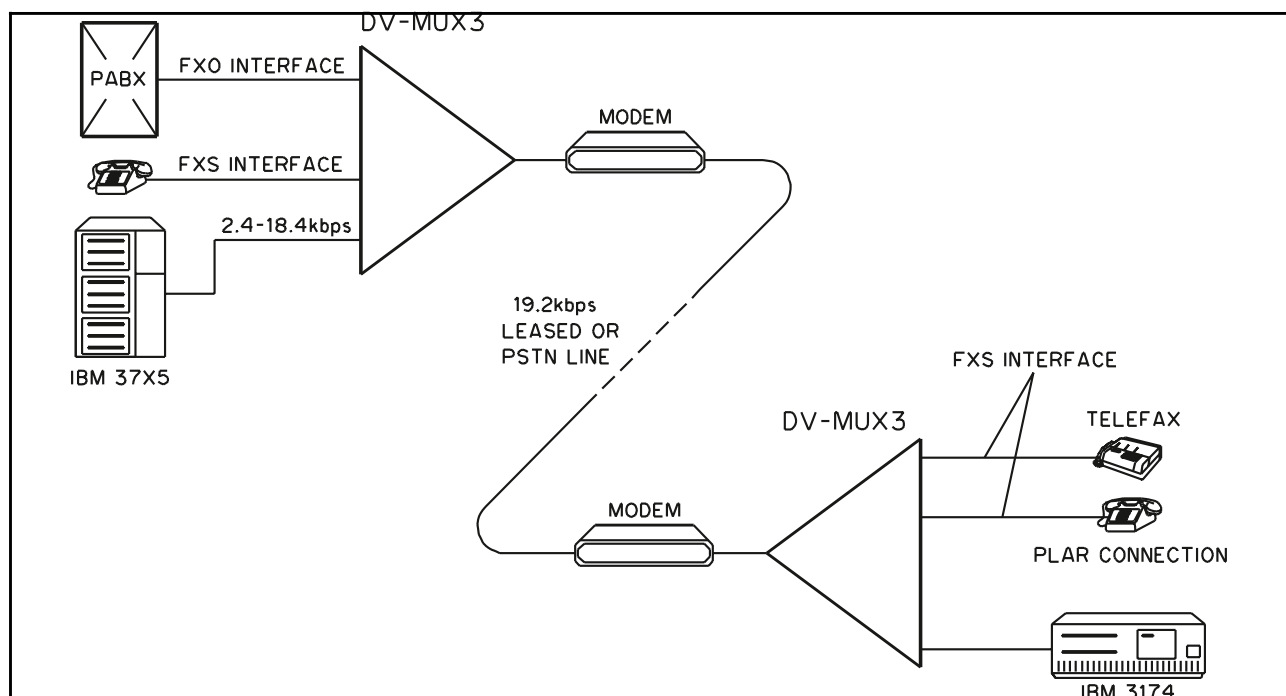


Figure 1-1. Typical DV-MUX3 Application in an SNA Link

In this example, the connection is made by sharing an already existing SNA link, based on 19.2 kbps modems operating over a telephone line. This link is being used to connect the IBM 3174 Cluster Controller located at the branch office to an IBM 37X5 Front End Processor located at the main offices.

The DV-MUX3 is inserted between the IBM 3174, respectively IBM 37X5, and the corresponding modem:

- The IBM 3174 and IBM 37X5 are connected to the data channels of the two DV-MUX3 units.
- One local subscriber line of the PABX located at the main offices is connected to the first voice channel of the DV-MUX3. This voice channel uses an FXO interface.

- The second voice channel of the DV-MUX3 is used for PLAR service, and is connected directly to the subscriber's telephone set. This voice channel uses an FXS interface.
- At the branch office, the two local subscriber sets are connected to the two voice channels of the DV-MUX3. These voice channels use the FXS interface.

The first voice channel (connected at the main office to a subscriber line of the PBX) is used for voice/fax transmission.

After the DV-MUX3 equipment is added, the data rate available to the SNA link depends on the main link rate and the selected voice bandwidth. In this example, the main link rate is 19.2 kbps; assuming the voice channels operate at 6.4 kbps, the guaranteed bandwidth available to the SNA link decreases to 5.6 kbps (faster modems, e.g., 28.8 kbps modems, would of course increase the guaranteed bandwidth).

However, the main advantage of using the DV-MUX3 in this application is the availability of an adaptive mode: by using the DV-MUX3 adaptive mode, the decrease in the bandwidth would occur only when a voice channel is actually in use, i.e., when someone makes a call: when the voice lines are idle, the bandwidth available to the SNA link is 18.4 kbps.

NOTE

IBM communication equipment uses the DSR line as an indication of channel activity. For such applications, an appropriately wired cable must be used to connect the DSR line to the DCD line of the DV-MUX3 data channel connector.

Note that the DSR line is supported only for the RS-232 interface.

Typical DV-MUX3 Application in an Inter-LAN Link

Figure 1-2 shows another typical application for a DV-MUX3. In this example, the DV-MUX3 is used to provide two telephone channels between the branch offices and the main offices by sharing an already existing data link. This link is used by a pair of remote Ethernet bridges or routers that interconnect the LANs serving the main and branch offices. The DV-MUX3 is inserted between the remote bridges and the data link, in a way similar to that shown in figure 1-1.

Other Applications

The adaptive mode of the DV-MUX3 also can be used when the available main link bandwidth is shared with statistical multiplexers, or with any other type of equipment that can run at the rate of the clock signals supplied to it. This issue is further explained in the *System Timing Considerations* section.

Dial-up Mode

The dial-up mode (available only when the main link interface is RS-232 or V.35) allows the use of a switched PSTN line to connect between two DV-MUX3 units, thereby reducing the operating cost as the line is used only on demand.

The dial-up mode requires the use of the master-slave configuration. For proper operation, the DV-MUX3 installed at the central location must be defined as the master, and the other DV-MUX3 must be defined as the slave.

Conditions for Activation/Deactivation of a Voice Channel

The DV-MUX3 interprets the following conditions as a request from a voice channel for the connection of the link to the remote DV-MUX3:

- **For a voice channel with FXS interface:** the detection of an off-hook condition at the voice channel interface.

- **For a voice channel with FXO interface:** the detection of incoming ringing at the voice channel interface.
- **For a voice channel with E&M interface:** the detection of an active M signal.

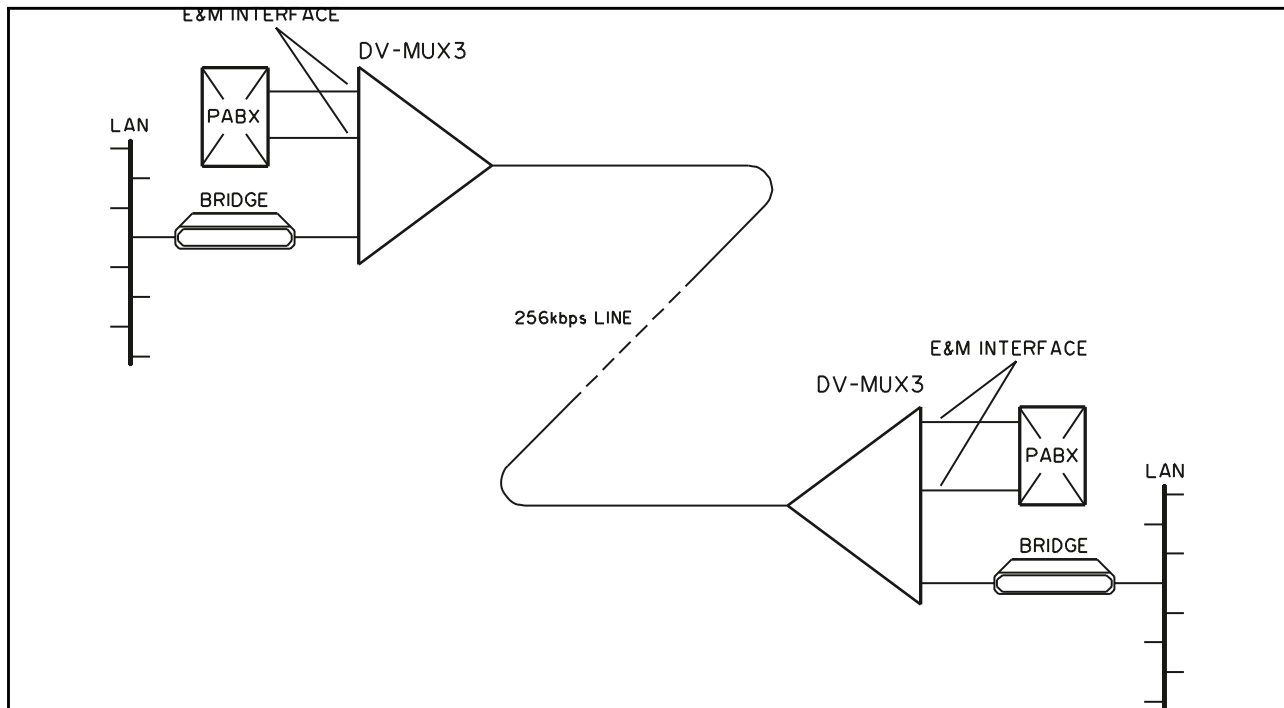


Figure 1-2. Typical DV-MUX3 Application in an Inter-LAN Link

The indication that a voice channel no longer needs the link to the remote DV-MUX3 is derived in the following ways:

- **For a voice channel with FXS interface:** the detection of switching from the off-hook to the on-hook condition. This is the normal way the communication on the voice channel is ended.
- **For a voice channel with FXO interface:** the stopping of the incoming ringing, but only if the remote subscriber did not go off-hook in response to the ringing. Note that if the remote subscriber has been off-hook, the ending of communication is controlled only by the remote subscriber.
- **For a voice channel with E&M interface:** the detection of an inactive M signal.

Conditions for Activation/Deactivation of the Data Channel

The indication that the user's terminal is active is derived from the state of the DTR line in the data channel interface (the terminal is assumed to be active when its DTR line is ON).

Conditions for Activation of Main Link

A DV-MUX3 will activate the main link to the other DV-MUX3 upon the detection of the first valid request for connection. The link will remain connected as long as at least one valid request is present.

- Valid connection requests originating from a voice channel can be made by either of the master, or the slave DV-MUX3, because the DV-MUX3 dial-up mode is designed to operate symmetrically with respect to voice channels.

This symmetry reflects the way voice channels are used (either side can initiate a call to the other side).

- Valid connection requests originating from the data channel can be made only by the slave DV-MUX3, because the DV-MUX3 dial-up mode is designed to operate asymmetrically with respect to the data channel. This means that a request for connecting the link to the other DV-MUX3 can be made only by the slave DV-MUX3.

This asymmetry reflects the way data systems operate: the equipment at the side of the master DV-MUX3 (Bridge, Front End Processor, etc.) is assumed to operate continuously, so that it is always ready to accept the connection to the remote equipment (i.e., the equipment at the slave DV-MUX3 side), but there is no point to maintain the connection when the remote equipment has nothing to send. This approach is particularly well suited to applications such as shown in figure 1-1, which are clearly asymmetrical. In the application shown in figure 1-1, the DV-MUX3 connected to the IBM 37X5 must be configured as the master.

Conditions for Disconnection of Main Link

The disconnection of the main link can be initiated only by the slave DV-MUX3. The disconnection is performed after both voice channels (on both DV-MUX3 units) are inactive and the DTR line in the slave data channel interface is OFF continuously for a period of 25 seconds.

The disconnection may also be initiated if the synchronization is lost for two seconds. This operation can also be performed by the master DV-MUX3.

Dial-up Modem Settings

Before starting the operation, the dial-up modems serving the main link must be configured as follows:

- Synchronous operation.
- Timing modem source:
 - Modem connected to the master DV-MUX3: internal clock.
 - Modem connected to the slave DV-MUX3: loopback timing (that is, its transmit timing must be locked to the recovered receive clock).
- Error correction and compression functions disabled.
- DTR dialing mode operation (DTR option 108.1).
- Program the directory number to be dialed by each modem.
- Configure each modem for switching to the originate mode upon assertion of the DTR line, and for switching to the answer mode upon detection of active RI line (that is, a modem must dial the preprogrammed number when the DTR line is asserted; if the DTR line is not asserted, the modem must answer automatically when the RI line is asserted).
- The disconnection time following the deassertion of the DTR line must be set to 50 msec.

NOTE

Correct clock source selection is essential for proper operation of the DV-MUX3. If the timing is not correctly selected, the DV-MUX3 may periodically lose synchronization.

Control over the Main Link Modems

The control of the dial-up modems serving the main link is made by means of the DTR line of the DV-MUX3 main link interface. Assuming that the modems were configured as explained above, the sequence for setting up and for disconnecting the link between two DV-MUX3 units is as follows:

- The link is in the disconnected state when no user traffic is present. Both DV-MUX3 units monitor the state of the RI line in their main link interface.
- When a voice channel at either the master or the slave DV-MUX3 is activated (see previous section), or the DTR line in the data channel interface of the slave DV-MUX3 is asserted, the corresponding DV-MUX3 asserts the DTR line in the main link interface. This causes the modem to dial the number preprogrammed by the user.
- When the remote DV-MUX3 senses the assertion of the RI line in its main link interface (indication of incoming call provided by the dial-up modem), it asserts the DTR and RTS lines in its main link interface, and tries to synchronize to the other DV-MUX3.
- In case the DV-MUX3 does not synchronize within 40 seconds, it switches the DTR line OFF. If a request for connection is still present, the DV-MUX3 returns the DTR line to ON after 100 msec. This interval is sufficient for the modem to disconnect, and then to start a new dialing attempt.
- When the two DV-MUX3 synchronize, they assert the CD and CTS lines in the data channel interfaces.
- Normally, the disconnection of the link is initiated by the slave DV-MUX3, after 25 seconds during which both voice channels are inactive and the DTR line in the slave data channel interface is OFF continuously. To disconnect, the slave DV-MUX3 switches the DTR line in the main link interface OFF. This causes the slave modem to go on-hook.

In case the master DV-MUX3 senses a loss of synchronization condition for two seconds, the master DV-MUX3 switches the DTR line in the main link interface OFF. This causes the master side modem to go on-hook.

System Bandwidth Utilization

Tables 1-1 and 1-2 list the bandwidth available to the DV-MUX3 data channel as a function of the number and digitizing rate of the voice channels:

- Table 1-1 provides the data channel bandwidths for the adaptive and non-adaptive 1 modes. Under **Idle Voice Channels**, you will find the bandwidth available, in the adaptive mode, for the data channel when both voice channels are idle.
- Table 1-2 provides the bandwidths for the non-adaptive 2 mode (this mode is intended for equipment limited to operation at standard data rates).

Table 1-1. Adaptive and Non-Adaptive 1 Modes, Data Channel Bandwidth as a Function of Voice Channel and Main Link Rates

Main Link Data Rate	Data Channel Bandwidth vs. Voice Channel Digitizing Rate										Idle Voice Channels (Adaptive mode only)
	One Voice Channel					Two Voice Channels					
	4.8 kbps	6.4 kbps	7.2 kbps	9.6 kbps	12.8 kbps	4.8 kbps	6.4 kbps	7.2 kbps	9.6 kbps	12.8 kbps	
9.6 kbps	4 kbps	2.4 kbps	1.6 kbps	—	—	—	—	—	—	—	8.8 kbps
12 kbps	6.4 kbps*	4.8 kbps	4.0 kbps	1.6 kbps	—	1.6 kbps	—	—	—	—	11.2 kbps
14.4 kbps	8.8 kbps	7.2 kbps*	6.4 kbps	4 kbps	0.8 kbps	4 kbps	0.8 kbps	—	—	—	13.6 kbps
16.8 kbps	11.2 kbps	9.6 kbps*	8.8 kbps	6.4 kbps	3.2 kbps	6.4 kbps	3.2 kbps	1.6 kbps	—	—	16 kbps
19.2 kbps	13.6 kbps	12 kbps	11.2 kbps	8.8 kbps	5.6 kbps	8.8 kbps	5.6 kbps	4 kbps	—	—	18.4 kbps
21.6 kbps	16 kbps	14.4 kbps*	13.6 kbps	11.2 kbps	8.0 kbps	11.2 kbps	8 kbps	6.4 kbps	1.6 kbps	—	20.8 kbps
24 kbps	18.4 kbps	16.8 kbps	16 kbps	13.6 kbps	10.4 kbps	13.6 kbps	10.4 kbps	8.8 kbps	4 kbps	—	23.2 kbps
26.4 kbps	20.8 kbps	19.2 kbps*	18.4 kbps	16.0 kbps*	12.8 kbps	16.0 kbps*	12.8 kbps	11.2 kbps	6.4 kbps	—	25.6 kbps*
28.8 kbps	23.2 kbps	21.6 kbps	20.8 kbps	18.4 kbps	15.2 kbps	18.4 kbps	15.2 kbps	13.6 kbps	8.8 kbps	2.4 kbps	28 kbps
32 kbps	26.4 kbps	24.8 kbps	24 kbps	21.6 kbps	18.4 kbps	21.6 kbps	18.4 kbps	16.8 kbps	12 kbps	5.6 kbps	31.2 kbps
38.4 kbps	32.8 kbps	31.2 kbps	30.4 kbps	28 kbps	24.8 kbps	28 kbps	24.8 kbps	23.2 kbps	18.4 kbps	12 kbps	37.6 kbps
48 kbps	41.6 kbps	40 kbps	39.2 kbps	36.8 kbps	33.6 kbps	36.8 kbps	33.6 kbps	32 kbps	27.2 kbps	20.8 kbps	46.4 kbps
56 kbps	49.6 kbps	48 kbps*	47.2 kbps	44.8 kbps	41.6 kbps	44.8 kbps	41.6 kbps	40 kbps	35.2 kbps	28.8 kbps	54.4 kbps
64 kbps	57.6 kbps	56 kbps*	55.2 kbps	52.8 kbps	49.6 kbps	52.8 kbps	49.6 kbps	48 kbps*	43.2 kbps	36.8 kbps	62.4 kbps
112 kbps	105.6 kbps	104 kbps	103.2 kbps	100.8 kbps	97.6 kbps	100.8 kbps	97.6 kbps	96 kbps*	91.2 kbps	84.8 kbps	110.4 kbps
128 kbps	121.6 kbps	120 kbps	119.2 kbps	116.8 kbps	113.6 kbps	116.8 kbps	113.6 kbps	112 kbps*	107.2 kbps	100.8 kbps	126.4 kbps
192 kbps	184 kbps	182.4 kbps	—	179.2 kbps	176.0 kbps	179.2 kbps	176 kbps	174.4 kbps	169.6 kbps	163.2 kbps	188.8 kbps
256 kbps	248 kbps	246.4 kbps	—	243.2 kbps	240.0 kbps	243.2 kbps	240 kbps	238.4 kbps	233.6 kbps	227.2 kbps	252.8 kbps

* In the non-adaptive 1 mode, these configurations yield standard data rates on the data channel, that can be used in addition to the data rates available in the non-adaptive 2 mode.

Table 1-2. Non-Adaptive 2 Mode, Data Channel Bandwidth as a Function of Voice Channel and Main Link Rates

Main Link Data Rate	Data Channel Bandwidth vs. Voice Channel Digitizing Rate									
	One Voice Channel					Two Voice Channels				
	4.8 kbps	6.4 kbps	7.2 kbps	9.6 kbps	12.8 kbps	4.8 kbps	6.4 kbps	7.2 kbps	9.6 kbps	12.8 kbps
9.6 kbps	3.6 kbps	2.4 kbps	1.2 kbps	—	—	—	—	—	—	—
12 kbps	2.4 kbps*	4.8 kbps	3.6 kbps	1.2 kbps	—	1.2 kbps	—	—	—	—
14.4 kbps	7.2 kbps	3.6 kbps	1.2 kbps	2.4 kbps	—	2.4 kbps	—	—	—	—
16.8 kbps	9.6 kbps	3.6 kbps	2.4 kbps	4.8 kbps	2.4 kbps	4.8 kbps	2.4 kbps	1.2 kbps	—	—
19.2 kbps	9.6 kbps	4.8 kbps	2.4 kbps	7.2 kbps	4.8 kbps	7.2 kbps	4.8 kbps	3.6 kbps	—	—
21.6 kbps	14.4 kbps	4.8 kbps	2.4 kbps	9.6 kbps	7.2 kbps	9.6 kbps	7.2 kbps	3.6 kbps	1.2 kbps	—
24 kbps	14.4 kbps	7.2 kbps	4.8 kbps	9.6 kbps	9.6 kbps	9.6 kbps	9.6 kbps	1.2 kbps	2.4 kbps	—
26.4 kbps	19.2 kbps	9.6 kbps	7.2 kbps	14.4 kbps	9.6 kbps	14.4 kbps*	9.6 kbps	4.8 kbps	4.8 kbps	—
28.8 kbps	19.2 kbps	9.6 kbps	7.2 kbps	14.4 kbps	14.4 kbps	14.4 kbps*	14.4 kbps	4.8 kbps	7.2 kbps	2.4 kbps
32 kbps	19.2 kbps	7.2 kbps	9.6 kbps	19.2 kbps	7.2 kbps	19.2 kbps	7.2 kbps	4.8 kbps	9.6 kbps	4.8 kbps
38.4 kbps	19.2 kbps	7.2 kbps	9.6 kbps	19.2 kbps	7.2 kbps	19.2 kbps	7.2 kbps	4.8 kbps	9.6 kbps	4.8 kbps
48 kbps	38.4 kbps	14.4 kbps	28.8 kbps	19.2 kbps	28.8 kbps	19.2 kbps	28.8 kbps	9.6 kbps	19.2 kbps	19.2 kbps
56 kbps	38.4 kbps	28.8 kbps	19.2 kbps	38.4 kbps	28.8 kbps	38.4 kbps	28.8 kbps	14.4 kbps	19.2 kbps	19.2 kbps
64 kbps	38.4 kbps	28.8 kbps	38.4 kbps	19.2 kbps	28.8 kbps	19.2 kbps	28.8 kbps	38.4 kbps	19.2 kbps	19.2 kbps
112 kbps	96.0 kbps	38.4 kbps	72 kbps	56 kbps	38.4 kbps	56 kbps	38.4 kbps	72 kbps	56 kbps	56.0 kbps
128 kbps	112.0 kbps	38.4 kbps	112 kbps	56 kbps	38.4 kbps	56 kbps	38.4 kbps	72 kbps	56 kbps	56.0 kbps
192 kbps	128.0 kbps	64 kbps	—	128 kbps	64.0 kbps	128 kbps	64 kbps	56 kbps	112 kbps	112.0 kbps
256 kbps	192.0 kbps	64 kbps	—	128 kbps	64.0 kbps	128 kbps	64 kbps	112 kbps	128 kbps	128.0 kbps

System Timing Considerations

This section explains the timing modes and clock rates available for the main link of the DV-MUX3, and for its data and voice channels.

Main Link Timing

The main link transmit and receive paths of the DV-MUX3 require external receive and transmit clock signals derived from the network clock. The transmit and receive clock must be derived from the same source. DV-MUX3 will however tolerate phase difference and jitter between the two clocks. Therefore, when the two DV-MUX3 units are connected through a modem link, one of the modems must be configured for operation with its internal clock, and the other must use loopback timing (operation on the recovered receive clock).

The main link clock signals always determine the DV-MUX3 receive and transmit timing. Thus, the DV-MUX3 always distributes downward the system timing.

The main link rate (any standard rate in the range of 9.6 to 256 kbps) is automatically identified by actually measuring the clock frequency. The DV-MUX3 will provide an alarm indication if the measured frequency is not close enough to one of the supported main link rates.

Data Channel Timing

The data channel supplies receive and transmit clock signals derived from the link clock to the attached equipment, and expects the user equipment to accept and generate data in accordance with these signals.

NOTE

When using the DV-MUX3 adaptive mode, it is strongly recommended to operate the equipment connected to the data channel with independent transmit and receive clock signals. This prevents the possibility of short error bursts occurring when dynamic bandwidth reallocation is performed.

When it is not possible to use independent transmit and receive clock signals, e.g., when the X.21 interface is used, and the occurrence of error bursts is undesirable, it is recommended to use the non-adaptive mode.

Voice Channel Timing

The voice channel digitizing rate (4.8, 6.4, 7.2, 9.6 or 12.8 kbps) is always locked to the main link receive clock.

1-3. TECHNICAL SPECIFICATIONS

General

Function	Three-channel adaptive multiplexer
Multiplexing Method	Bit-interleaved Time Division Multiplexing (TDM)
Management and Supervision	
Overhead	<ul style="list-style-type: none">– 0.8 kbps for main link data rates of 9.6 to 32 kbps– 1.6 kbps for data rates of 48 to 128 kbps– 3.2 kbps for data rates higher than 128 kbps

Main Link Characteristics

Data Rate	9.6 to 256 kbps, automatically recognized
Timing	Externally clocked
Interface	Synchronous V.24/RS-232, V.35, V.36/RS-449, RS-530, or X.21 interface (strap selectable), configured as DTE
Connector	15-pin D-type female connector. Adapter cable for ordered interface is supplied

Data Channel Characteristics

Data Rate	0.8 to 252.8 kbps, depending on mode and main link rate
ADAPTIVE mode	<i>Main Link Rate - Voice Channels Rate - Overhead</i> if at least one voice channel is active. <i>Main Link Rate - Overhead</i> if both voice channels are idle. See detailed list of values in Table 1-1
NON-ADAPTIVE 1 mode	<i>Main Link Rate - Voice Channel Rate - Overhead.</i> See detailed list of values in Table 1-1
NON-ADAPTIVE 2 mode	See detailed list of values in Table 1-2
Clocking	Receive and transmit clocks derived from the main link clock
Interface	Synchronous V.24/RS-232, V.35, V.36/RS-449, RS-530, or X.21 (strap selectable), configured as DCE
Interface connector	15-pin D-type female connector. Adapter cable for ordered interface is supplied

Voice Channels Characteristics

Voice Channels	One or two
Digitizing Technique	MPMLQ low bit rate digitizing technique per ITU-T Rec. G.723 at 4.8, 6.4, 7.2, 9.6 or 12.8 kbps
Fax	In band fax support at fax rate 2.4, 4.8, 7.2 or 9.6 kbps
End-to-End Processing Delay	120 msec
Acceptable Channel Bit Error Ratio	1×10^{-3} or better
Analog Interface (in accordance with order)	<ul style="list-style-type: none">– 2-wire FXO– 2-wire FXS– 2-wire/4-wire E&M

Analog Characteristics (9.6 kbps)	
Nominal transmit level	+2 to -13 dBm, independently adjustable for each channel in steps of 1 \pm 0.15dB
Nominal receive level	Independently adjustable for each channel in steps of 1 \pm 0.15dB
FXS, E&M	+2 to -13 dBm
FXO	+1 to -13 dBm
Frequency response (referred to 1020 Hz)	\pm 0.5 dB, 300-3000 Hz \pm 1.1 dB, 250-3400 Hz
Signal-to-distortion @ 9.6 kbps (ITU-T Rec. G.712, G.713, method 2)	0 to -30 dBm0: better than 33 dB +3 to -45 dBm0: better than 22 dB
Idle channel noise	Better than -70 dBm0
Adaptive Echo Canceler	
Integral module echo path length	8 msec
Echo return loss enhancement (ERLE)	>30 dB
Convergence speed	Better than ITU-T Rec. G.165
Dial pulse distortion	\pm 4 msec max
Connector	8 pin RJ-45 connector for each channel
Fax Characteristics	
Standards	Supports Group 3 fax machines complying with ITU-Rec. T.4 and T.30
Fax Data Rates/Channel Bandwidth	2.4 kbps/4.8 kbps 4.8 kbps/6.4, 7.2 kbps 7.2 kbps/9.6 kbps 9.6 kbps/12.8 kbps all with auto-fallback
FXS Interface	
Nominal impedance	600 Ω
Return loss (300 to 3400 Hz)	Better than 20 dB
Feed current	25 mA at 300 Ω loop resistance
Ringer	45Vrms (\pm 10%), overload protected, 22Hz (\pm 10%), 1 second ON, 3 seconds OFF
FXO Interface	
Off-hook	EIA RS-464: loop start
DC impedance	150 Ω at 100 mA feed 330 Ω at 25 mA feed
AC input impedance	600 Ω
Return loss	Better than 22 dB

On-hook	
DC resistance	More than 1 M Ω
AC impedance	20 k Ω at 20 Hz, 70 Vrms
Ring detect range	>20 Vrms, 17 to 25 Hz
Transformer isolation	3000 Vrms
E&M Interface	
Signaling interface	<ul style="list-style-type: none"> – EIA RS-464 Type I – Modified EIA RS-464 Type II, III, V (with -24V instead of -48V) – British Telecom SSDC5
Analog interface	4-wire or 2-wire interface, strap selectable
AC impedance	600 Ω
Transformer isolation	1500 Vrms
Diagnostics	
	Two push-buttons used for activation of remote loops and BERT on the data channel, or tone injection on the voice channel. Tested channel is selected by a front panel switch
Indications	
	<ul style="list-style-type: none"> – Transmit and receive data activity indicators for the link, voice channel or data channel. The monitored channel is selected by a front panel switch – Sync loss indication – Test indication – Power on indication – Configuration error indication – Self-test failure indication – Incorrect main link clock rate indication
Configuration Downloading	
	Master/slave mode available. Allows all the channel parameters selected on the master unit to be downloaded through the main link to the slave unit
Power	
DC supply voltage	-48 VDC
AC supply voltage	100, 115 or 230 VAC, $\pm 10\%$, 47-63 Hz
Power consumption	15 VA
Physical Characteristics	
Height	4.4 cm/1.7 in
Width	19.3 cm/7.6 in
Depth	24.0 cm/9.4 in
Weight	2.7 kg/6.0 lb
Environment	
Temperature	0 to +45°C (32 to +104°F)
Humidity	Up to 90%, non-condensing

CHAPTER 2.

INSTALLATION

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2-1. GENERAL

The DV-MUX3 is delivered completely assembled. It is designed for installation as a desk-top unit and for mounting in a 19" rack.

General installation procedures for DV-MUX3 are provided in the following paragraphs. For rack installation instructions, refer to Appendix C.

After installing the unit, refer to Chapter 3 for operating instructions.

In case a problem is encountered, refer to Chapter 4 for test and diagnostics instructions.



WARNING

No internal settings, adjustment, maintenance, and repairs may be performed by either the operator or the user; such activities may be performed only by a skilled technician who is aware of the hazards involved.

Always observe standard safety precautions during installation, operation, and maintenance of this product.

2-2. UNPACKING

A preliminary inspection of the equipment container should be made before unpacking. Evidence of damage should be noted and reported immediately.

To unpack, place the container on a clean flat surface, cut all straps, and open or remove top. Carefully take out the DV-MUX3 and all the accessories packed in the container, and place them securely on a clean surface. Inspect the product for damage. Immediately report any damage.

2-3. SITE REQUIREMENTS

Power

AC-powered DV-MUX3 units should be installed within 1.5 m (5 feet) of an easily-accessible grounded AC mains outlet capable of furnishing the nominal supply voltage of the DV-MUX3 (in accordance with your order). The supply voltage is marked on a label located on the rear panel, near the power connector.

DC-powered DV-MUX3 units require a -48 VDC source.

The DV-MUX3 does not include a power switch, and will start operating as soon as its power cable is connected to power. Therefore, a circuit breaker located at a convenient location, that will also serve as an on/off switch, must be included in the circuit used to provide power to the DV-MUX3.

Cable Connections

The DV-MUX3 has two 15-pin female D-type connectors (one connector for the data channel, and the other connector for the main link) and two RJ-45 connectors for the two voice channels. Various adapter cables are available for interface conversion. Appendix A provides connector pin allocations, and wiring data for the adapter cables.

Front and Rear Panel Clearance

When the DV-MUX3 is installed in a 19" rack, allow at least 90 cm (36 inches) of frontal clearance for operator access. Allow at least 10 cm (4 inches) clearance at the rear of the unit for interface cable connections.

Ambient Requirements

The ambient operating temperature of the DV-MUX3 should be 0 to 45°C (32 to 104°F), at a relative humidity of up to 90%, non-condensing.

Do not place another unit on top a DV-MUX3 unit, because this will obstruct the free flow of cooling air around the unit,

2-4. DV-MUX3 CONFIGURATION INFORMATION

General

The DV-MUX3 contains several printed circuit boards, identified in figure 2-1:

- Main board. This board contains most of the DV-MUX3 circuits.
- Voice channels module. In accordance with your order, this module can include one or two voice channels.
- Voice channel interface modules. Three types of voice channel interface boards are available:
 - DV-MUX3-FXO for FXO interface.
 - DV-MUX3-FXS for FXS interface.
 - DV-MUX3-E&M for E&M interface.

Figure 2-1 shows two interface modules installed on the voice channels module. One interface module is required for each voice channel. The appropriate module is factory-installed in accordance with your order.

Prior to DV-MUX3 installation, the internal jumpers and switches located on these boards must be set in accordance with your requirements, as explained below.

This paragraph provides information on the functions of the internal jumpers and switches located on each board, and provides step-by-step instructions for making the internal settings.



WARNING

ELECTRICAL SHOCK HAZARD

Access to the inside of the equipment is only permitted to qualified and authorized service personnel.

Disconnect the unit from all the cables and from the power line before removing the power cord.

Line voltage is present inside the DV-MUX3 when it is connected to power. Moreover, external fault conditions may cause dangerous high voltages to appear on the voice channel cables connected to the DV-MUX3. Observe all the applicable safety precautions, and in particular always disconnect all the cables connected to it, and then disconnect the input power from the DV-MUX3 before disconnecting the DV-MUX3 power cord from the enclosure.

Any adjustment, maintenance, and repair of the opened instrument under voltage should be avoided as much as possible and, when inevitable, should be carried out only by a skilled person who is aware of the hazard involved. Capacitors inside the instrument may still be charged even after the instrument has been disconnected from its source of supply.

CAUTION

The DV-MUX3 contains components sensitive to electrostatic discharge (ESD). To prevent ESD damage, avoid touching the internal components, and before moving jumpers, touch the DV-MUX3 frame.

Opening DV-MUX3 Case

The DV-MUX3 jumpers are located on its boards. The boards are attached to the rear panel. To reach the internal jumpers:

- Disconnect all the cables connected to the DV-MUX3.
- Unscrew the two large captive screws located on the rear panel.
- Carefully pull the rear panel out. The internal boards will slide out together with the panel. The DV-MUX3 has several tall components which barely clear the top cover: make sure you do not damage these components.

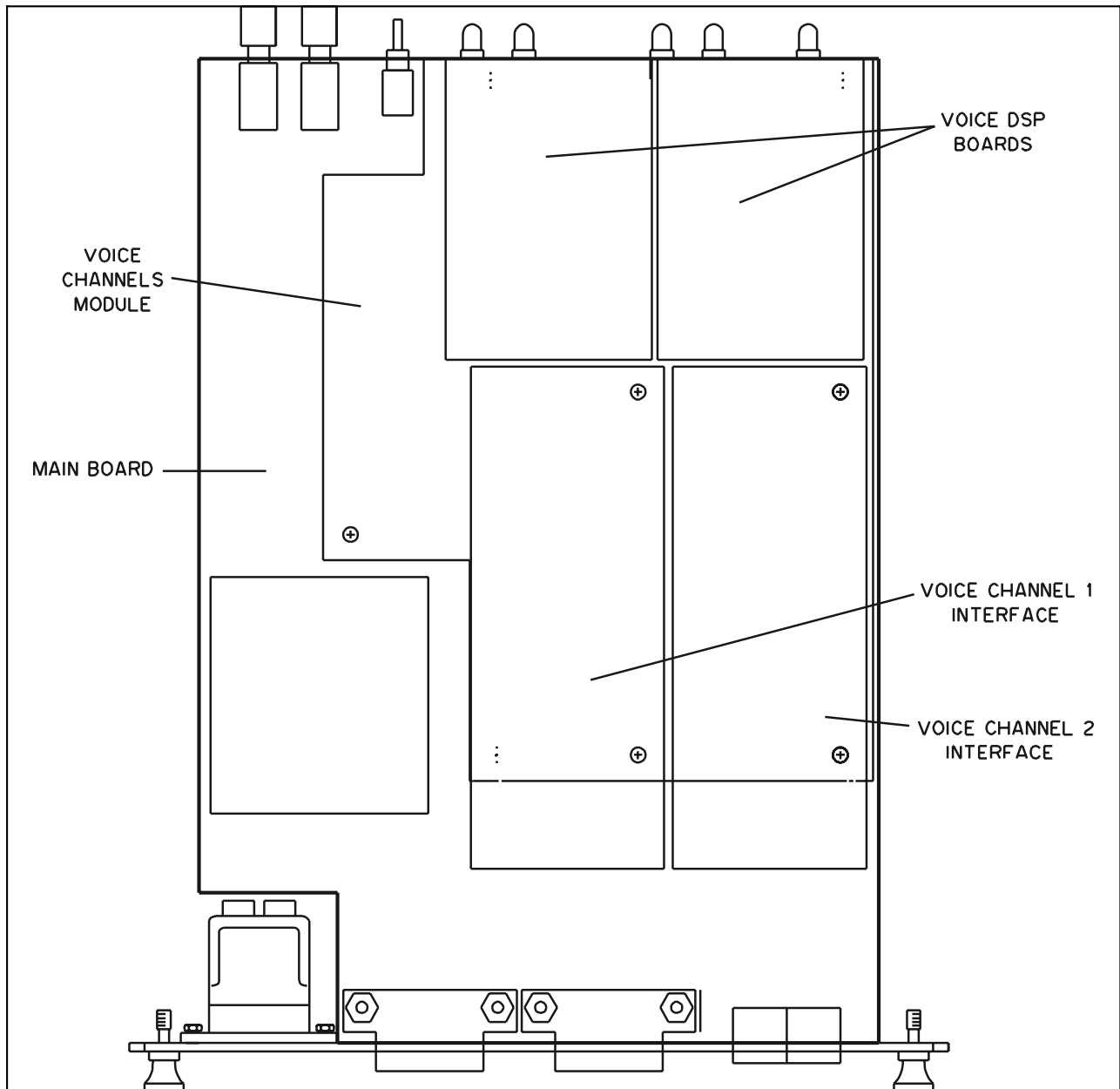


Figure 2-1. DV-MUX3, Identification of Internal Modules

Main Board Jumpers

The user-selectable jumpers located on the main board of the DV-MUX3 are identified in figure 2-2.

In addition to the jumpers identified in figure 2-2, the main board includes additional factory-set jumpers which must not be moved.

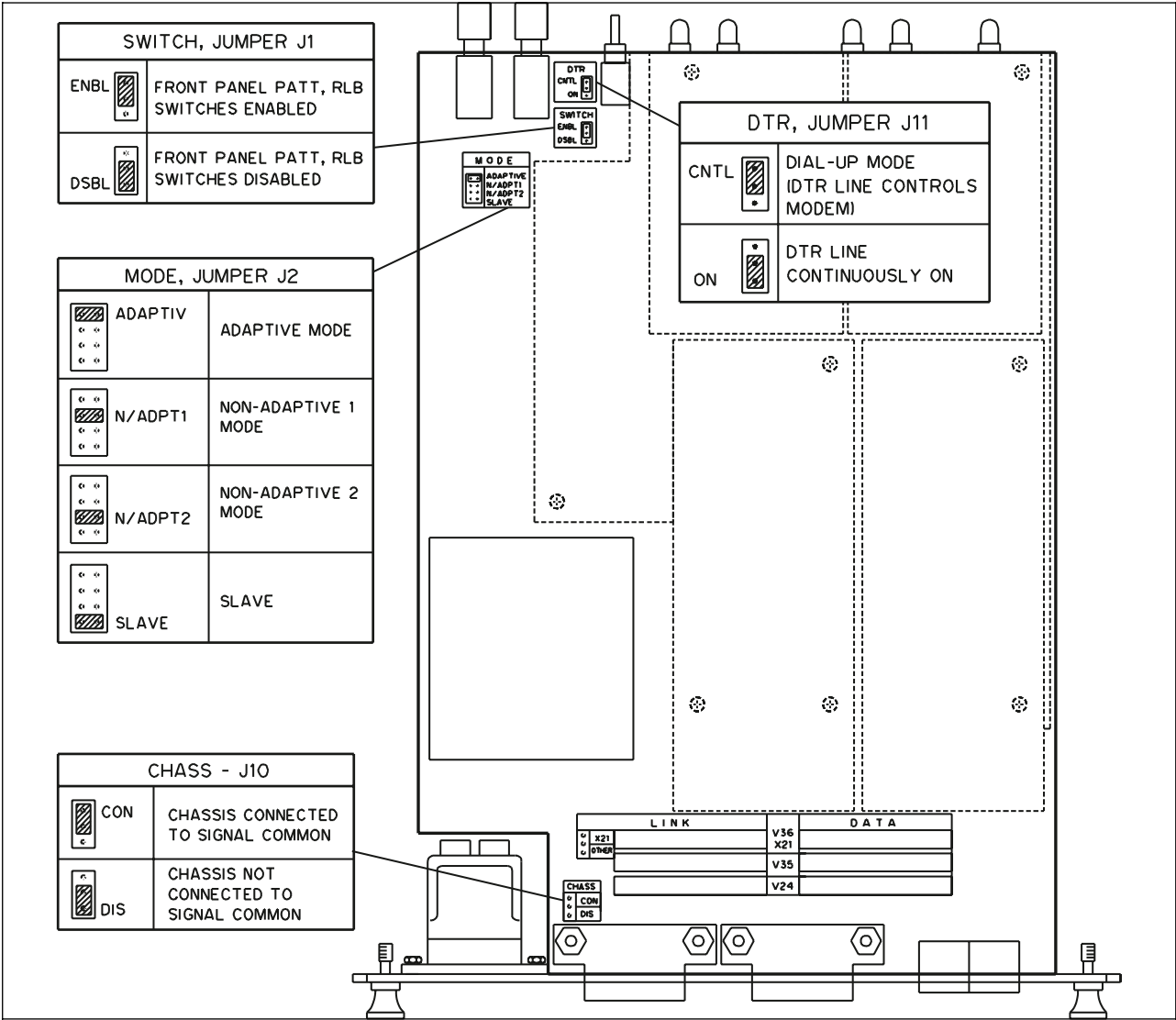


Figure 2-2. DV-MUX3, Identification of Main Board Jumpers

MODE Selection Jumper, J2

This jumper selects the DV-MUX3 bandwidth allocation mode, and its configuration mode. The jumper has four positions:

ADAPTIV

The DV-MUX3 operates as a master, and uses the adaptive bandwidth allocation mode. In this mode, the DV-MUX3 detects the main link data rate, allocates the bandwidth configured for voice channels, and assigns the remaining bandwidth (less the link management overhead) to the data channel. In addition, when the voice channel is idle, the DV-MUX3 automatically reallocates its bandwidth to the data channel. The ADAPTIV mode ensures that the

main link bandwidth is always fully utilized, however not all types of user equipment can support the dynamic changes in clock rate that occur in this mode.

See Table 1-1 for the available data rates.

N/ADPT1

The DV-MUX3 operates as a master, and uses the non-adaptive 1 allocation mode. In this mode, the DV-MUX3 determines the data rate of the data channel as in the adaptive mode, except that the bandwidth required by the voice channel is permanently allocated. This mode achieves the best utilization of the main link bandwidth when the data channel data rate cannot be dynamically changed.

See Table 1-1 for the available data rates.

N/ADPT2

The DV-MUX3 operates as a master, and uses the non-adaptive 2 allocation mode. In this mode, the DV-MUX3 allocates the data channel the highest standard data rate that fits within the bandwidth left after allowing for the voice channel and link management and supervision overhead.

See Table 1-2 for the available data rates.

SLAVE

DV-MUX3 operates as slave unit, that is, its configuration is determined by the information downloaded through the main link by the remote unit.

The use of a master-slave configuration expedites link setup and reduces the chance of configuration errors, therefore whenever feasible, set the MODE jumper of one of the DV-MUX3 units operating in a link to the SLAVE position.

If you set the jumper to this position on both units operating in a link, a configuration error indication (TEST indicator flashing, SYNC LOSS indicator off) will be displayed after the DV-MUX3 units synchronize.

The default setting is ADAPTIV.

NOTE

In a master-slave configuration, the allocation mode set on the DV-MUX3 unit selected as master is downloaded to the slave unit, and overrides the local slave setting. The master-slave configuration is mandatory for the dial-up mode.

SWITCH Control Jumper, J1

This jumper allows to disable the front-panel PATT and RLB push-buttons, to prevent the activation of tests and loops by unauthorized persons.

The jumper has two positions:

ENBL

The front-panel push-buttons can control the activation of tests and loops.

DSBL

The front-panel push-buttons are disabled and do not have any effect.

The default setting is ENBL.

DTR Jumper, J11

This jumper is used to enable the dial-up mode.

The dial-up mode can be enabled only when the DV-MUX3 main link interface uses the RS-232 interface. For other interfaces, the dial-up mode is not available, irrespective of the setting of this jumper.

The jumper has two positions:

CNTL When the RS-232 interface is selected, the dial-up mode is enabled. In this case, the DV-MUX3 controls the state of the DTR line in the main link interface as explained in para. 1-2.

ON The dial-up mode is disabled, and the DTR line in the main link interface is ON as long as the DV-MUX3 is powered.

The default setting is ON.

CHASS Jumper, J10

This jumper controls the connection between the signal ground lines to the chassis ground line. The appropriate position must be determined by the installation manager. The jumper has two positions:

CON signal ground connected to chassis ground.

DIS signal ground disconnected from chassis ground.

Factory setting is CON.

Voice Channels Module

The switches located on the voice channels module are identified in figure 2-3.

NOTE In a master-slave configuration, the digitizing rate and the number of voice channels selected on the voice channels module of the DV-MUX3 unit selected as master are downloaded to the slave unit.

Digitizing Rate Switch, SW6

This switch selects the voice channels digitizing rate. The switch has two sections, designated S1 and S2.

Table 2-1 lists the digitizing rate selection.

Table 2-1. Digitizing Rate Selection

SW6 Section			Digitizing Rate
S1	S2	S3	
0	0	0	4.8 kbps
1	0	0	6.4 kbps
0	1	0	7.2 kbps
0	0	1	9.6 kbps
0	1	1	12.8 kbps

The default setting is 6.4 kbps.

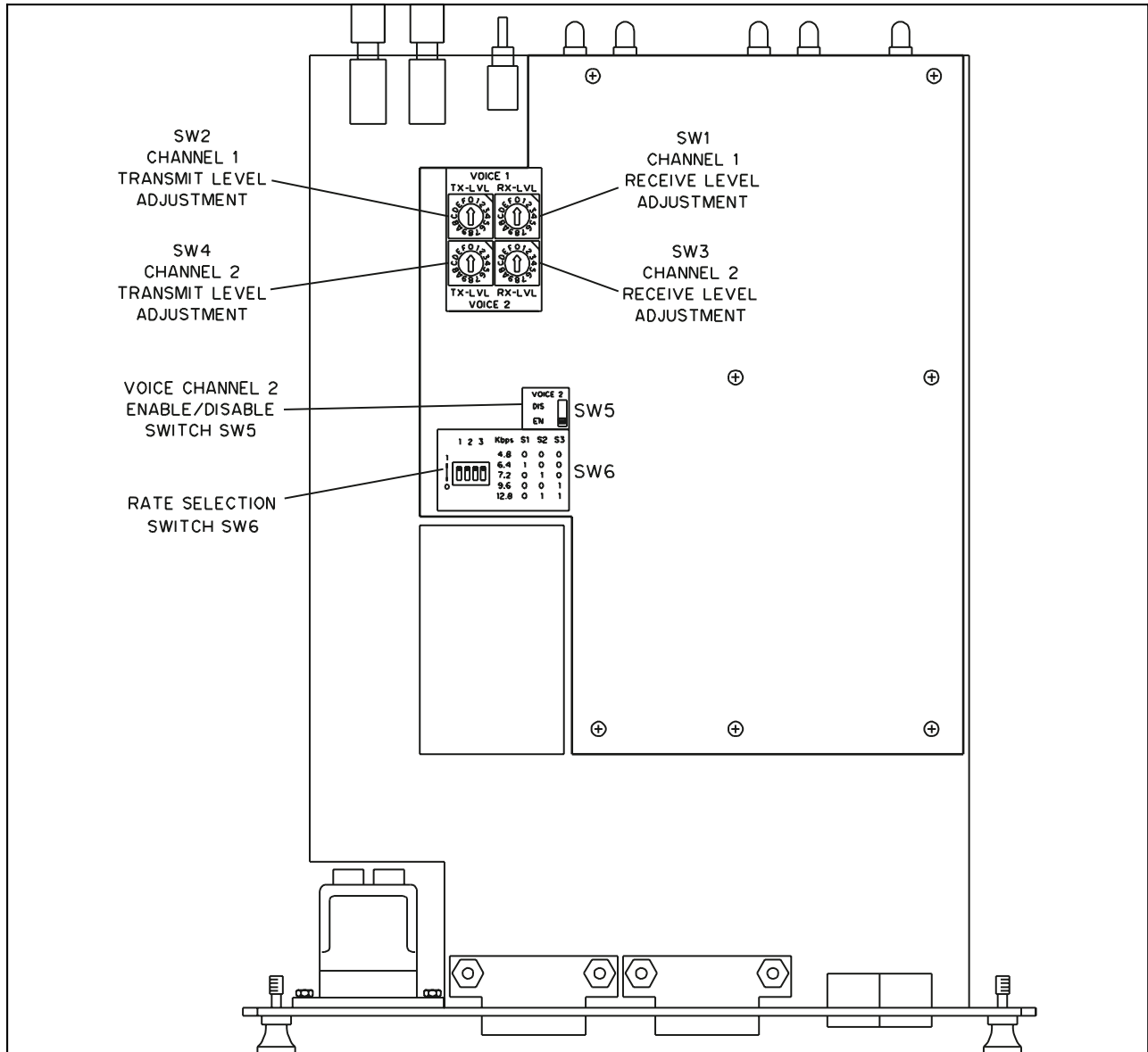


Figure 2-3. Voice Channels Module Switches

VOICE2 Enable Switch, SW5

On DV-MUX3 units equipped with two voice channels, this switch allows the user to disable voice channel 2. By disabling voice channel 2, the bandwidth available to the data channel is increased.

The switch has two positions:

- **DIS** - voice channel 2 is disabled.
- **EN** - voice channel 2 is enabled.

The default setting is EN.

Level Adjustment Switches, SW1, SW2, SW3, SW4

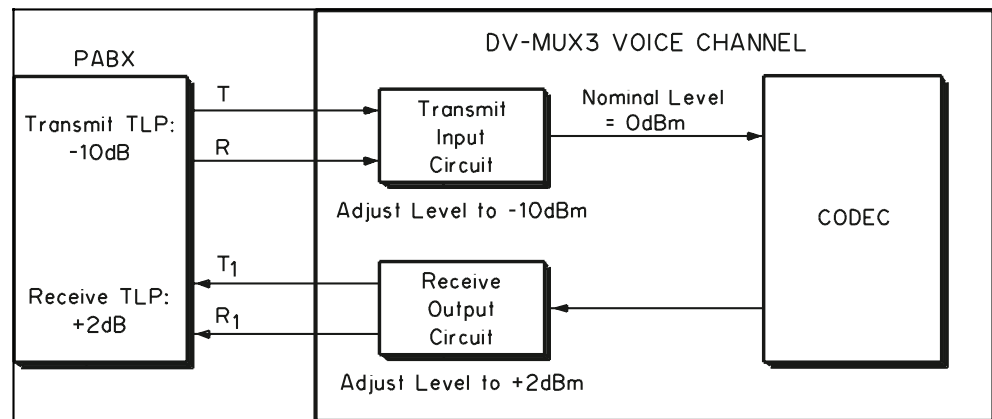
These switches are used to select the nominal input and output levels of the voice channels:

- SW1 selects the nominal output level of the voice channel 1 receive path.
- SW2 selects the nominal input level of the voice channel 1 transmit path.
- SW3 selects the nominal output level of the voice channel 2 receive path.
- SW4 selects the nominal input level of the voice channel 2 transmit path.

The application of an input signal at the nominal transmit level results in a 0 dBm0 digital level, that yields a far-end output signal level equal to the far-end nominal receive level. Figure 2-4 explains how to determine the required levels.

NOTE

Figure 2-4. Selection of Transmit and Receive Levels



The input and output levels can be set in 1-dB steps in the range of +2 dBm to -13 dBm, according to Table 2-2. In addition, a reference table is attached to the top of the power transformer.

Table 2-2. Voice Channel Level Adjustment

Level (dBm)	Switch Position
+2	E
+1	F
0	0
-1	1
-2	2
-3	3
-4	4
-5	5
-6	6
-7	7
-8	8
-9	9
-10	A
-11	B
-12	C
-13	D

NOTE

For the FXO interface, the maximum level is +1 dBm, therefore position E should not be selected.

Default: 0 dBm for both the transmit and receive levels.

**Voice Channel
Interface Modules**

Only the DV-MUX3-E&M voice channel interface board requires internal settings that are used to select the signaling mode and the interface type, 2W or 4W. Figure 2-5 identifies the position of these switches.

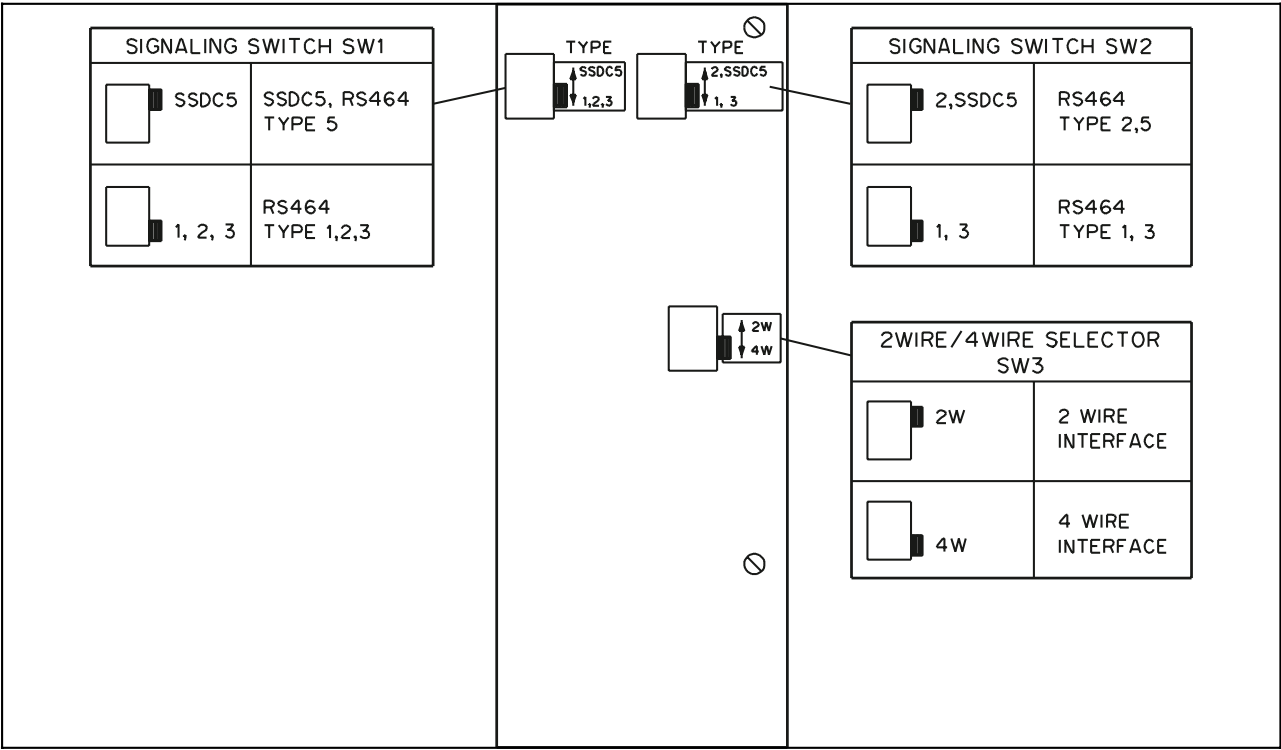


Figure 2-5. DV-MUX3-E&M, Internal Settings

**E&M Signaling
Mode Selection**

The DV-MUX3-E&M module supports five E&M signaling modes: RS-464 Type I, II, III and Type V, and British Telecom SSDC5. To help you determine the appropriate signaling mode, figure 2-6 shows the equivalent signaling circuit in each mode. The selection of the signaling mode is made by setting the two switches to the appropriate position.

Table 2-3 lists the required settings.

Table 2-3. Selection of E&M Signaling Mode

Signaling Mode	Settings	
	SW2 Switch Position	SW1 Switch Position
RS-464 Type I	TYPE 1,3	TYPE 1,2,3
RS-464 Type II	2, SSDC5	TYPE 1,2,3
RS-464 Type III	TYPE 1,3	TYPE 1,2,3
RS-464 Type V	2, SSDC5	SSDC5
BT SSDC5	2, SSDC5	SSDC5

Default setting is EIA RS-464 Type II signaling.

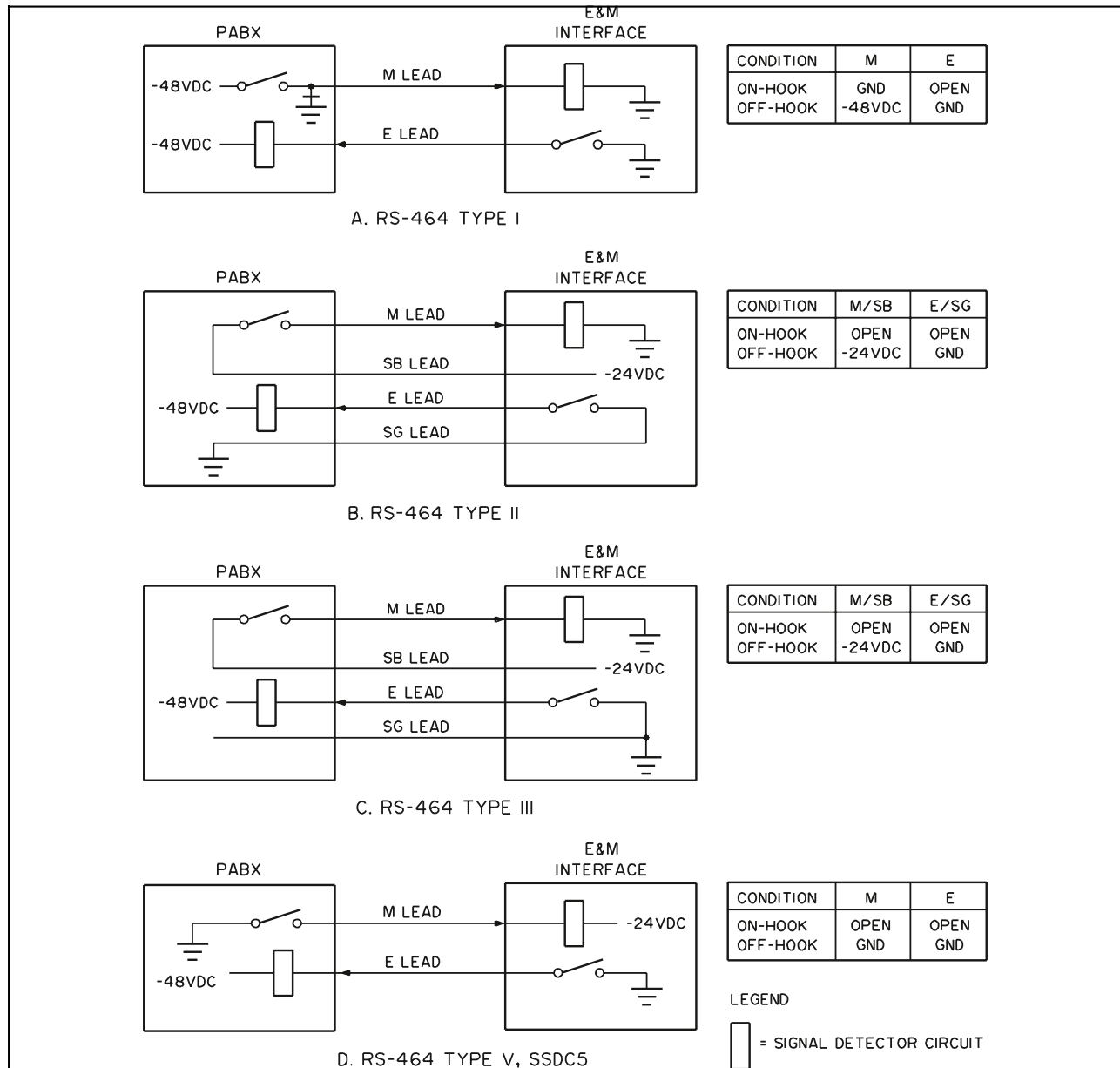


Figure 2-6. Equivalent Signaling Circuits

**2W/4W Selection,
Switch SW3**

Switch SW3 selects the analog interface:

2W 2-wire interface**4W** 4-wire interface**Default setting is 4W.****Internal Settings
Procedure**

Refer to figures 2-1 through 2-6 and identify jumper and switch locations and settings. Change settings as required.

After completing the internal settings, reinstall the DV-MUX3 as follows:

- Insert the front side of the DV-MUX3 board into **both** card guides (grooves) on the internal side of the case walls, and then carefully slide the board in. Be careful to prevent damage to the tall components. If resistance is felt before the rear panel touches the case, pull the board out and then repeat the procedure.
- Fasten the rear panel by fully screwing in the two large rear panel screws.

2-5. CABLE CONNECTIONS

General

Figure 2-7 shows a typical rear panel for an AC-powered DV-MUX3 unit. The rear panel of DC-powered units is similar, except it includes a three-pin circular DC power connector.

The DV-MUX3 has two 15-pin D-type female connectors located on the rear panel, one for connection to the main link, and the other for the data channel. In addition, the DV-MUX3 rear panel includes two RJ-45 connectors for the two voice channels.

Appendix A lists the pin allocations for the various connectors, and provides information on the adapter cables available for each connector.

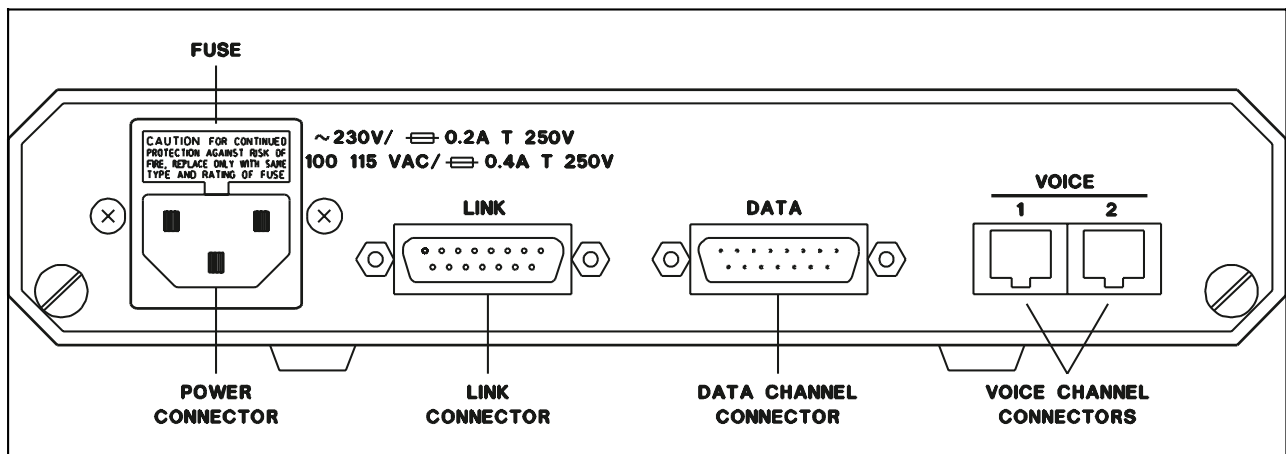


Figure 2-7. Typical DV-MUX3 Rear Panel (AC-Powered Unit)

Grounding

For your protection, the DV-MUX3 must always be grounded. Any interruption of the protective (grounding) conductor (inside or outside the instrument) or disconnecting the protective earth terminal can make this instrument dangerous. Intentional interruption is prohibited.

Power Connections

The DV-MUX3 does not have an on/off switch, therefore it will start operating as soon as power is connected.

**WARNING**

BEFORE POWERING UP this instrument and before connecting any other cable the protective earth terminals of this instrument must be connected to the protective conductor of the power cord. The power plug shall only be inserted in a socket outlet provided with a protective earth contact. The protective action must not be negated by use of an extension cord (power cable) without a protective conductor (grounding).

Make sure that only fuses with the required rated current are used for replacement. The use of repaired fuses and the short-circuiting of fuse holders must be avoided.

Whenever it is likely that the protection offered by fuses has been impaired, the instrument must be made inoperative and be secured against any unintended operation.

AC Power Connection

Skip this section for DC-powered DV-MUX3 units.

CAUTION

The DV-MUX3 is available in models that differ in the rated supply voltage (100 VAC, 115 VAC or 230 VAC).

Before first-time installation, check that the DV-MUX3 nominal supply voltage, marked on a label on its rear panel, matches the nominal voltage available at your mains outlet.

AC power should be supplied to the DV-MUX3 through the standard power cable terminated by a standard 3-prong plug. Connect the cable between the AC power connector on the DV-MUX3 rear panel and a standard grounded AC outlet that provides a nominal voltage equal to the DV-MUX3 nominal supply voltage.

DC Power Connection

Skip this section for AC-powered DV-MUX3 units.

Connect the DC power cable to the DV-MUX3 DC power connector, and then connect the other end to the DC power source. Pay attention to correct polarity.

Main Link Connection

DV-MUX3 main link interface is configured as a DTE interface, intended for connection to a synchronous modem that is capable of providing the clock signals that determine DV-MUX3 main link data rate.

The main link connector is a 15-pin D-type female connector, wired in accordance with ITU-T Rec. X.21. When a different interface is selected by means of the internal jumpers, an interface conversion adapter cable must be inserted between the DV-MUX3 main link connector and the cable connecting to the main link modem. The following adapter cables are available:

- | | |
|--------------------|---|
| V.36/RS-449 | Use CBL-KM-22/449 adapter cable, terminated in a 37-pin female D-type connector. |
| RS-530 | Use CBL-KM-22/530 adapter cable, terminated in a 25-pin female D-type connector. |
| V.35 | Use CBL-DV-MUX/V.35 adapter cable, terminated in a 34-pin female connector. |
| V.24/RS-232 | Use CBL-DV-MUX/232/N adapter cable, terminated in a 25-pin female D-type connector. |

Data Channel Connections

The DV-MUX3 data channel interface is configured as a data communication equipment (DCE) interface, thereby allowing direct connection to data terminal equipment (DTE).

The data channel connector is a 15-pin D-type female connector, wired in accordance with ITU-T Rec. X.21.

When a different interface is selected by means of the internal jumper, an interface conversion adapter cable must be inserted between the DV-MUX3 and the cable connecting the user's equipment. The required adapter cables are the same cables listed above for the main link connector.

Voice Channel Connections

Each voice channel connector is terminated in an 8-pin RJ-45 connector.

CHAPTER 3.

OPERATING INSTRUCTIONS

Contents	Page
DV-MUX3 Front Panel Controls and Indicators	3-1
Preparation for Operation, General	3-3
Operating Instructions	3-4

3-1. DV-MUX3 FRONT PANEL CONTROLS AND INDICATORS

Table 3-1 lists the functions of the DV-MUX3 controls and indicators located on the front panel. The Item numbers in Table 3-1 correspond to the index numbers in figure 3-1.

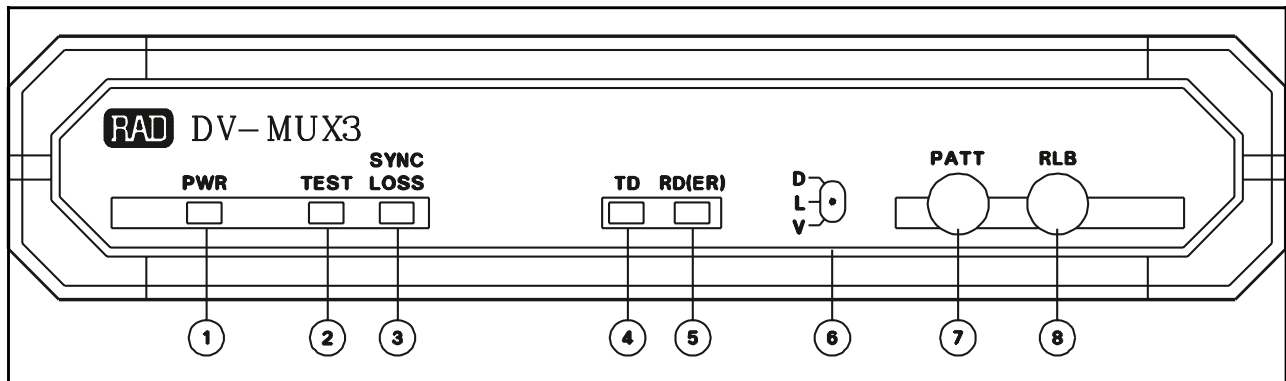


Figure 3-1. DV-MUX3 Front Panel Controls and Indicators

Table 3-1. DV-MUX3 Controls and Indicators

Item	Control or Indicator	Function
1	PWR indicator	Lights when the DV-MUX3 is powered
2	TEST indicator	Lights steadily when a BERT test, tone injection, or a remote loop is active on the DV-MUX3. Flashes (0.5 second on/0.5 second off) when a configuration error occurs
3	SYNC LOSS indicator	Lights when the DV-MUX3 is not frame-synchronized
4	TD indicator	Lights to indicate the presence of data on the transmit pair of the channel selected by means of the SELECT switch (item 6)
5	RD/ER indicator	During normal operation, lights steadily to indicate the presence of data on the receive pair of the channel selected by means of the SELECT switch (item 6) During BERT testing, lights when errors are detected.
6	SELECT switch	Selects a channel for testing (by means of the PATT and RLB push-buttons, items 7 and 8) and for monitoring (by the TD and RD indicators, items 4 and 5): D Data channel L Main link V Voice channel
7	PATT push-button	Activates the transmission of a 511-bit pseudo-random test sequence on the data channel, and the detection of errors in the received sequence (BERT testing), or the tone injection (1000 Hz, 0dBm0) on the voice channel(s). This function can be disabled by an internal switch
8	RLB push-button	Controls the activation of a remote loop on the channel selected by the SELECT switch (item 6). This function can be disabled by an internal switch

Special Diagnostic Indications

In addition to the basic indications listed in Table 3-1, additional fault conditions can be indicated. The indications used for these conditions are combinations of display states based on simultaneous lighting of SYNC LOSS and the flashing of the TEST indicator, and a specific state of the TD and RD/ERR indicators. The available indications are as follows:

TD and RD/ER both ON Failure in power-up self-test (EPROM checksum or the internal hardware test failed), or the voice channels module is not installed. The DV-MUX3 should be repaired.

TD and RD/ER both OFF The DV-MUX3 main link interface does not receive clock signals, or the main link clock rate measured by the DV-MUX3 does not fit any of the supported rates, or the rate is outside the allowable accuracy limits.

Configuration Error Indication

The flashing of the TEST indicator while the SYNC LOSS indicator is off indicates a configuration error. The configuration error indication is displayed under the following circumstances:

- Bandwidth “overflow”: the total bandwidth assigned to the data and voice channels, including the link synchronization and supervision overhead, exceeds the main link data rate determined by measuring the link clock signal frequency.
- Both DV-MUX3 units connected in a link are configured as “slaves”.
- Both DV-MUX3 units connected in a link are configured as “masters”, and their configurations are different.
- A master DV-MUX3 unit with two active voice channels attempts to download configuration information to a slave unit having only one voice channel.
- The local DV-MUX3 operator has depressed the RLB push-button to activate a remote loopback on a channel on which a loopback has already been activated by the other side.

3-2. PREPARATION FOR OPERATION, GENERAL

After being prepared for operation according to Chapter 2, the DV-MUX3 normally operates unattended.

Operator intervention is only required when the DV-MUX3 is set-up for the first time, or must be adapted to new operational requirements that require the changing of the internal settings.

3-3. OPERATING INSTRUCTIONS

Preliminary Settings Release all the push-buttons.

Turn-on The DV-MUX3 does not have a power switch, therefore it immediately starts operating when power is applied. To apply power, connect the DV-MUX3 power cable to its rear POWER connector, then plug the other end into a grounded mains outlet.

When power is connected, the DV-MUX3 performs self-test. During self-test, all the indicators light for approximately 0.5 second, then change to the normal states.

The PWR indicator remains lit as long as power is available.

Normal Operating Indications During normal operation, all the front-panel indicators, except PWR, and possibly TD and RD (see following section), are off.

NOTE Upon turn-on, the SYNC LOSS alarm indicator may light up, indicating that the other communication equipment serving the DV-MUX3 link is not yet operating. The indicator must turn off as soon as all the link equipment is operated.

In case the SYNC LOSS indicator lights and/or the TEST indicator flashes, refer to Chapter 4 for troubleshooting instructions.

The TEST indicator will light steadily when a test is activated.

Monitoring Channel Activity To monitor traffic activity on a desired channel or on the main link, set the SELECT switch to the corresponding position.

The TD and RD/ERR indicators show the traffic activity on selected channel (their brightness is proportional to the traffic load). If the TD and RD/ERR indicators are off while the selected channel transmits or receives data, refer to Chapter 4 for troubleshooting instructions.

NOTE The PATT and RLB push-buttons can be disabled by an internal switch. When disabled, the TEST indicator remains off when a push-button is pressed.

Loop Activation When it is necessary to activate a test loop, set the SELECT switch to the position corresponding to the desired channel, and then press the RLB push-button. The TEST indicator turns on, and the TD and RD indicators show data activity on the transmit and receive pairs of the selected channel.

The loop remains activated as long as the RLB push-button remains depressed. Note that the activation of a main link loop interrupts the service to all the users served by the DV-MUX3 link, whereas a channel loop interrupts only the user traffic on the selected channel.

When the loop is no longer required, release the depressed push-button by pressing it again. The TEST indicator turns off.

Refer to Chapter 4 for a description of the test loops.

BERT Activation

To activate the BERT test, set the SELECT switch to the DATA position, and then press the PATT push-button. The TEST indicator turns on, the TD indicator must light, and the RD/ERR indicator lights if errors are detected (ideally, the RD/ERR indicator should remain off during the test).

NOTES

1. The BERT test can be activated only on the data channel. Pressing the PATT push-button when the SELECT switch is set to LINK has no effect.
2. In order to obtain meaningful results from the BERT test, the local DV-MUX3 must receive, on the tested channel, a test pattern similar to the transmitted pattern. This can be achieved either by connecting a remote loop on the same channel, or by simultaneously activating the BERT test at the remote DV-MUX3 (provided the link is operating properly). Otherwise, the DV-MUX3 will not receive the test sequence and will indicate errors.

The BERT test continues as long as the PATT push-button remains depressed. Note that the activation of the BERT test interrupts the service to the users of the selected channel.

When the test can be stopped, release the depressed push-button by pressing it again. The TEST indicator turns off.

Refer to Chapter 4 for a description of the BERT test.

Tone Injection

To activate tone injection, set the SELECT switch to the VOICE position, and then press the PATT push-button. The TEST indicator turns on.

The remote side should hear a 1000-Hz tone at the nominal channel level (0 dBm). The RD/ERR and TD indicators continue operating as usual.

NOTES

1. The echo canceler used on the voice channels cannot perform its function when the same tone is simultaneously transmitted and received. Therefore, do not try to activate tone injection together with a remote loopback, nor activate simultaneously tone injection at both the local and the remote DV-MUX3.
2. Tone injection is simultaneously activated on both voice channels, therefore it interrupts the service to the users of the two channels.

Tone injection continues as long as the PATT push-button remains depressed. Note that tone injection interrupts the service to the users of the voice channels.

When tone injection can be stopped, release the depressed push-button by pressing it again. The TEST indicator turns off.

Refer to Chapter 4 for a description of the tone injection.

Turn-off

Disconnect the power cable from the mains outlet, and then from the DV-MUX3 rear power connector.

CHAPTER 4.

DIAGNOSTICS

Contents	Page
General	4-1
Description of Diagnostic Functions	4-2
Troubleshooting Instructions	4-5

4-1. GENERAL

Three types of diagnostic functions are available:

- Remote loopback.
- BERT testing (available only on the data channel).
- Tone injection (available only on the voice channels).

The BERT, tone injection, and remote loop are initiated from the front panel PATT and RLB push-buttons, respectively, on the channel selected by means of the SELECT switch. The operating procedures are explained in para. 3-3. For a functional description of the test functions available on each channel, refer to para. 4-2.

The activation of the tests can be disabled by an internal switch, located on the DV-MUX3 main board (figure 2-2). If troubleshooting is required and the DV-MUX3 does not respond to the PATT and RLB push-buttons, first check the position of the switch.

When performing tests, observe the following guidelines and restrictions:

- Activation of a channel test or loop interrupts the service to the users served by the DV-MUX3 channel under test.
- Activation of the main link loop interrupts the service to all the users served by the DV-MUX3 link.
- On any channel, only one DV-MUX3 can activate a remote loopback. If the remote loopback has already been activated by the other DV-MUX3, the TEST indicator starts flashing (indication of configuration error).

4-2. DESCRIPTION OF DIAGNOSTIC FUNCTIONS

General

A test or loop is activated on the channel selected by the SELECT switch by depressing the corresponding DV-MUX3 front-panel push-button. As long as any test or loop is activated, the TEST indicator lights.

To deactivate the test or loop, press the same push-button again. If this was the only active test or loop, the TEST indicator will turn off.

The commands for the activation/deactivation of remote loops is transmitted end-to-end through the main link. Therefore, when a remote loop is activated, the DV-MUX3 TEST indicators light at both ends of the link.

BERT Test

The BERT test is available only on the data channel. This test is used to obtain a rapid qualitative evaluation of data transmission without using external test equipment.

When the test is activated, a test signal is applied to the selected channel of the DV-MUX3. The test signal, an internally-generated $2^9 - 1$ (511) bit pseudo-random sequence, is internally connected to the input of the tested channel transmit path. The transmitted data can either be returned to the receive path of the channel by means of a loop somewhere along the data path (e.g., by connecting the remote channel loop, or by a physical loopback connection), or a similar sequence can be transmitted from the other end of the data channel (either by simultaneously activating the BERT test at the remote DV-MUX3 or by connecting a test pattern generator).

The received signal is routed to an internal test sequence evaluator. The evaluator compares the received data, bit by bit, to the original data and detects any difference (bit error). Each detected error is indicated by flashing the RD/ERR indicator.

While the BERT test is activated, the CD and CTS lines in the local data channel connector are set low (inactive).

Tone Injection

The test tone (1000 Hz, 0 dBm) is a digital sequence repeating at a rate of 1000 Hz generated by the digital voice processor and sent to the remote side. The sequence is identical to the data stream that would have been generated if a 1000 Hz signal at a nominal level of 0 dBm were applied to the input of the voice channel being tested. Therefore, the remote user can hear the tone in the telephone earpiece, and can also make measurements using test equipment.

When the DV-MUX3 is equipped with a voice module with two channels, the tone is simultaneously sent on both channels.

Since the tone is sent in only one direction (toward the remote DV-MUX3), the other direction operates as usual.

The tone canceler suppresses the tone on the receive side of the local voice channel, therefore any attempt to activate tone injection at both ends of the link, or to use a remote loopback while the tone is sent, will not allow you to hear the tone.

Remote Data Channel Loopback

During a remote data channel loop, the local channel transmit data is multiplexed by the local DV-MUX3 and sent to the remote DV-MUX3.

At the remote DV-MUX3, the data channel is demultiplexed, the receive data is looped back to the transmit path of the remote data channel, and then returned through the link to the local data channel as received data.

While the loop is activated, the CD and CTS lines in the remote data channel interfaces are set low (inactive).

Figure 4-1 shows the loop connections. As long as the loop is activated and the link connecting the two DV-MUX3 units operates properly (i.e., both the local and remote SYNC LOSS indicators remain off), the data equipment connected to the local DV-MUX3 must receive its own signals without errors, and the local RD indicator must light when the local TD indicator lights.

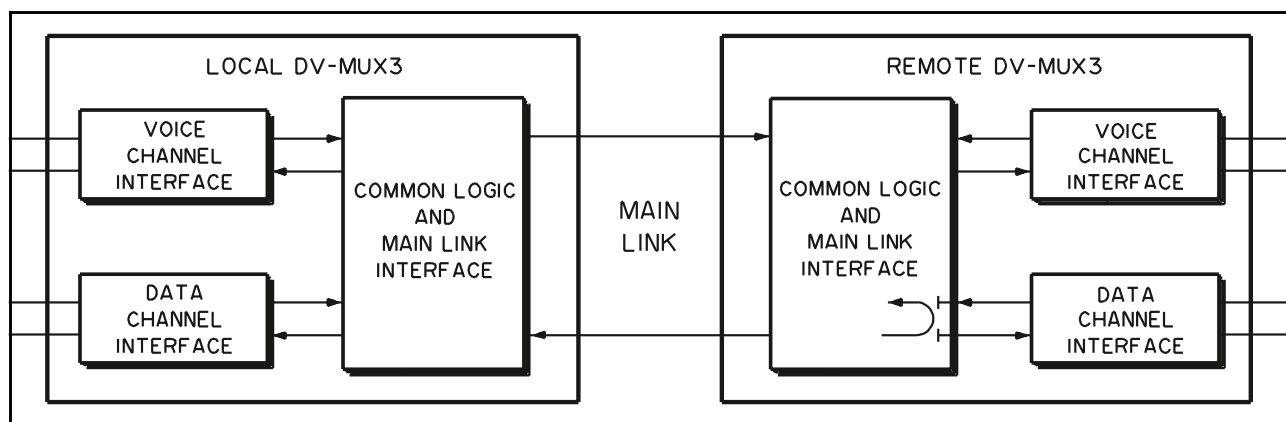


Figure 4-1. Data Channel, Remote Loopback

Remote Voice Channel Loopback

The voice channel remote loopback is similar to the data channel loopback. While the loopback is connected, the subscriber connected to the local DV-MUX3 must receive his/her own voice clearly and loudly.

During the voice channel remote loopback, the voice channel will be disconnected on the remote side.

Remote Main Link Loopback

During the remote main link loopback, both the voice and data transmit data are looped back by the remote DV-MUX3 to the receive side of the local DV-MUX3, demultiplexed and applied to the two channels as received data.

Figure 4-2 shows the loop connections.

The indications and the response of the data channel user's data equipment are the same as for the data channel loopback, and that of the voice channel, the same as for the voice channel remote loopback.

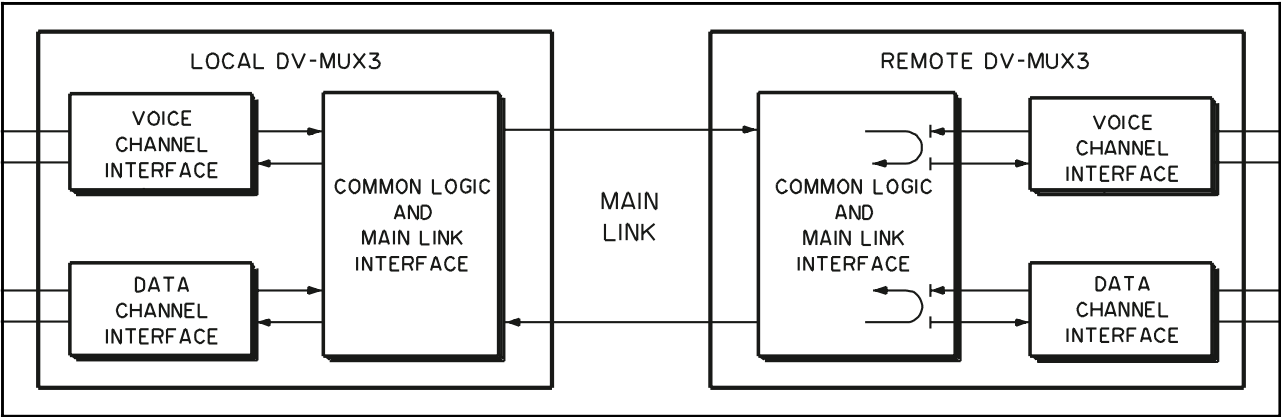


Figure 4-2. Main Link Remote Loopback

4-3. TROUBLESHOOTING INSTRUCTIONS

In case a problem occurs, refer to Table 4-1, identify the closest description of the trouble symptoms and perform the actions listed under “Corrective Measures” in the order given, until the problem is corrected.

Whenever the problem appears upon first-time operation of a new link, or just after the configuration of an existing link has been changed, before starting the troubleshooting check again all the internal settings of the local and remote DV-MUX3 units against the prescribed parameters.

Table 4-1. Troubleshooting Chart

No.	Symptoms	Probable Cause	Corrective Measures
1	PWR off	1. No AC power	Check that both ends of the AC power cable are properly connected, and that power is available at the mains outlet to which the DV-MUX3 is connected.
		2. Blown fuse	Replace with fuse of proper rating
		3. Defective DV-MUX3	Replace the DV-MUX3
2	TEST SYNC LOSS TD, RD/ERR flashes lights lights	Local DV-MUX3 failed self-test	Check whether the voice channels module is installed. Replace the local DV-MUX3
3	TEST SYNC LOSS TD, RD/ERR flashes lights off	Local DV-MUX3 does not receive valid clock signals from the data communication equipment connected to its main link connector	Check that the connection cable between the local DV-MUX3 and the data communication equipment connected to its main link connector is in order. Check that the data communication equipment is configured to operate as a DCE and that it supplies transmit and receive clock signals at the correct rate to the DV-MUX3
4	TEST SYNC LOSS off lights	1. Problem in the data transmission facility	Perform troubleshooting of the data transmission facility that connects the two DV-MUX3
		2. Problem at local DV-MUX3	Activate the local loopback on the DCE equipment connected to the main link. If the SYNC LOSS indicator continues to light, replace the local DV-MUX3
		3. Problem at the remote DV-MUX3	Repeat the procedure given for probable causes above on the remote DV-MUX3

Table 4-1. Troubleshooting Chart (Cont'd)

No.	Symptoms	Probable Cause	Corrective Measures
5	TEST flashes SYNC LOSS off	Configuration error	Check for the following possible errors, and correct if necessary: <ul style="list-style-type: none"> – Both the local and remote DV-MUX3 are configured as slave units. – Both are configured as master units, and the parameters are different. – Both are configured as master units, and the MODE jumper settings are different. – Both are in remote loopback in the same channel
6	SYNC LOSS lights intermittently	Receive clock and transmit clock are not from the same source	If the modem on one side is set to transmit timing, the modem on the other side must be set to loopback timing.
7	TEST off SYNC LOSS off The local voice channel voice user cannot hear, and/or cannot setup calls. Local data channel operates normally	1. Incorrect selection of voice channel interface, or problem in the channel connection cables	Check that the proper interface is used: an FXO interface must be connected to a PABX, an FXS interface must be connected to a telephone set, and an E&M interface must be connected to the E&M interface of the PABX. Check the connection cables.
		2. Problem at local DV-MUX3	Activate tone injection at the remote DV-MUX3, and check that the test tone is heard. Deactivate tone injection, activate the voice channel loop, and check that a strong sidetone is heard in the telephone set earpiece. If not, replace the local DV-MUX3 (fault on main board, or on interface board, is suspected)
		3. Problem at remote DV-MUX3	Repeat the procedure given above for the remote DV-MUX3.
8	TEST off SYNC LOSS off The local data channel user does not receive data. Voice channel operates normally	1. Problem on the cables, or on the line between the DTE and DV-MUX3	Activate the data channel loopback and BERT test. If the RD/ERR indicator of the local DV-MUX3 does not light (no errors), check the cables and the line between the DV-MUX3 and the DTE.
		2. Problem at Local DV-MUX3	If the RD/ERR indicator of the local DV-MUX3 lights during the above test, replace the local DV-MUX3
		3. Problem at the remote DV-MUX3	Repeat the procedure given above for the remote DV-MUX3

APPENDIX A.

CONNECTION DATA

Contents	Page
Scope	A-1
Main Link and Data Channel Interfaces	A-2
Voice Channel Interface	A-7
DC Power Connector	A-8

A-1. SCOPE

This Appendix provides information on the type and pin allocation of the various DV-MUX3 interface connectors. In addition, the Appendix provides information on adapter cables. Note that the cables offered by RAD for use with the main link and data channels are identical, despite some slight differences in the pin functions.

In the direction field, the following conventions are used:

- IN - input to DV-MUX3
- OUT - output from DV-MUX3
- N.C. - Not used

A-2. MAIN LINK AND DATA CHANNEL INTERFACES

Interface Connectors The main link and data channel interface connectors are 15-pin D-type female connectors.

NOTE

The following tables also present the direction of the signals in the main link and the data channel connectors.

X.21 Pin Allocations When the selected interface is X.21, the connector is wired in accordance with ITU-T Rec. X.21. Connector pin allocations are listed in Table A-1.

Table A-1. Main Link Interface Connector, X.21 Interface

DB-15 Interface Connector Pin	Direction		Function
	LINK	DATA	
1	–	–	Frame ground (shield)
2	OUT	IN	TX data - A wire
3	OUT	N.C	RTS - A wire (main link only)
4	IN	OUT	RX data - A wire
5	N.C	OUT	Carrier detect - A wire (data channel only)
6	IN	OUT	Signal timing - A wire
7	–	–	Not connected
8	–	–	Signal ground
9	OUT	IN	TX data - B wire
10	OUT	N.C	RTS - B wire (main link only)
11	IN	OUT	RX data - B wire
12	N.C	OUT	Carrier detect - B wire (data channel only)
13	IN	OUT	Signal timing - B wire
14	–	–	Not connected
15	–	–	Not connected

**V36/RS-449
Interface Adapter
Cable**

The V.36/RS-449 interface adapter cable, CBL-KM-22/449, is terminated on the user's side in a 37-pin D-type female connector, wired as listed in Table A-2.

Table A-2. V.36/RS-449 Interface Adapter Cable

DB-15 Interface Connector Pin	DB-37 Connector Pin (User's Side)	Designation	Direction		Function
			LINK	DATA	
1	1	Shield	–	–	Frame ground (shield)
2	4	SD(A)	OUT	IN	TX data - A wire
3	7	RS(A)	OUT	N.C	Request to send - A wire (main link only)
4	6	RD(A)	IN	OUT	RX data - A wire
5	13	RR(A)	N.C	OUT	Carrier detect - A wire (data channel only)
6	5	ST(A)	IN	OUT	Transmit clock - A wire
7	8	RT(A)	IN	OUT	Receive clock - A wire
8	19	–	–	–	Signal ground
9	22	SD(B)	OUT	IN	TX data - B wire
10	25	RS(B)	OUT	N.C	Request to send - B wire (main link only)
11	24	RD(B)	IN	OUT	RX data - B wire
12	31	RR(B)	N.C	OUT	Carrier detect - B wire (data channel only)
13	23	ST(B)	IN	OUT	Transmit clock - B wire
14	26	RT(B)	IN	OUT	Receive clock - B wire
15	–	–	–	–	Not connected

**RS-530 Interface
Adapter Cable**

The RS-530 interface adapter cable, CBL-KM-22/530, is terminated on the user side in a 25-pin D-type female connector, wired as listed in Table A-3.

Table A-3. RS-530 Interface Adapter Cable

DB-15 Interface Connector Pin	DB-25 Connector Pin (User's Side)	Designation	Direction		Function
			LINK	DATA	
1	1	AA	–	–	Frame ground (shield)
2	2	BA(A)	OUT	IN	TX data - A wire
3	4	CA(A)	OUT	N.C	Request to send - A wire (main link only)
4	3	BB(A)	IN	OUT	RX data - A wire
5	8	CF(A)	N.C	OUT	Carrier detect - A wire (data channel only)
6	15	DB(A)	IN	OUT	Transmit clock - A wire
7	17	DD(A)	IN	OUT	Receive clock - A wire
8	7	AB	–	–	Signal ground
9	14	BA(B)	OUT	IN	TX data - B wire
10	19	CA(B)	OUT	N.C	Request to send - B wire (main link only)
11	16	BB(B)	IN	OUT	RX data - B wire
12	10	CF(B)	N.C	OUT	Carrier detect - B wire (data channel only)
13	12	DB(B)	IN	OUT	Transmit clock - B wire
14	9	DD(B)	IN	OUT	Receive clock - B wire
15	–	–	–	–	Not connected

**V.35 Interface
Adapter Cable**

The V.35 interface adapter cable, CBL-DV-MUX/V.35, is terminated on the user side in a 34-pin female connector, wired as listed in Table A-4.

Table A-4. V.35 Interface Adapter Cable

DB-15 Interface Connector Pin	DB-34 Connector Pin (User's Side)	ITU-T Rec. V.35 Circuit	Direction		Function
			LINK	DATA	
1	A	101	–	–	Frame ground (shield)
2	P	103	OUT	IN	TX data - A wire
3	C	105	OUT	N.C	Request to send (main link only)
4	R	104	IN	OUT	RX data - A wire
5	F	109	N.C	OUT	Carrier detect (data channel only)
6	Y	114	IN	OUT	Transmit clock - A wire
7	V	115	IN	OUT	Receive clock - A wire
8	B	102	–	–	Signal ground
9	S	103	OUT	IN	TX data - B wire
10	H	108.1	OUT	IN	Data terminal ready
11	T	104	IN	OUT	RX data - B wire
12	J	125	IN	–	Ring indicator
13	AA	114	IN	OUT	Transmit clock - B wire
14	X	115	IN	OUT	Receive clock - B wire
15	D	106	N.C	OUT	Clear to send (data channel only)

**V.24/RS-232
Interface Adapter
Cable**

The V.24/RS-232 interface adapter cable, CBL-DV-MUX/232/N, is terminated on the user side in a 25-pin D-type female connector, wired as listed in Table A-5.

Table A-5. V.24 Interface Adapter Cable

V.24	15-Pin Connector	25-Pin Connector	Line Designation	Direction		Function
				LINK	DATA	
112	1	1	CHAS	–	–	Frame ground (shield)
103	2	2	TD	OUT	IN	TX data
105	3	4	RTS	OUT	IN	Request to send
104	4	3	RD	IN	OUT	RX data
109	5	8	CD	N.C	OUT	Carrier detect
114	6	15	TC	IN	OUT	Transmit clock
115	7	17	RC	IN	OUT	Receive clock
102	8	7	SG	–	–	Signal ground
–	11, 13, 14	–	–	–	–	Not used
108.1	10	20	DTR	OUT	IN	Data terminal ready
125	12	22	RI	IN	–	Ring indicator
106	15	5	CTS	N.C	OUT	Clear to send
107	9	6	DSR	IN	OUT	Data set ready

A-3. VOICE CHANNEL INTERFACE

The voice channel interface has 8-pin RJ-45 connectors, wired as listed in Tables A-6 and A-7.

Table A-6. FXO and FXS Voice Channel Interfaces, Connector Wiring

Pin	Designation	Function
1, 2, 3	—	Not connected
4	RING	2W voice input/output
5	TIP	2W voice input/output
6, 7, 8	—	Not connected

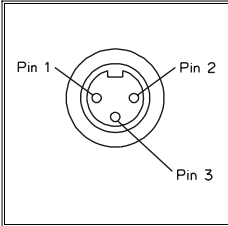
Table A-7. E&M Voice Channel Interface, Connector Wiring

Pin	Designation	Function
1	SB	Signaling battery
2	M	M lead input
3	R1-OUT	4-wire voice output 2-wire input/output
4	R-IN	4-wire voice input
5	T-IN	4-wire voice input
6	T1-OUT	4-wire voice output 2-wire input/output
7	SG	Function depends on signaling mode: RS-464 Type I, III Direct connection to signal ground RS-464 Type V, SSDC5 Connection to signal ground through 1.1 k Ω resistor RS-464 Type II SG lead
8	E	E lead output

A-4. DC POWER CONNECTOR

The DC power connector is a three-pin circular connector, wired in accordance with Table A-8. Pin locations are also identified.

Table A-8. DC Power Connector Wiring

	Pin	Function
	1	Ground
	2	Not connected
	3	Negative supply line (-48 VDC)

APPENDIX B.

DV-MUX3 WITH MIX OPTION

Contents	Page
General	B-1
Interchange of Interface Boards	B-2

B-1. GENERAL

Among other configurations, DV-MUX3 units can be operated in back-to-back configurations (figure B-1). For such applications, each DV-MUX3 must include one FXO interface and one FXS interface (this configuration is ordered under the MIX option). DV-MUX3 units with the MIX option are delivered with the FXO interface installed on channel 1, and with the FXS interface installed on channel 2. Therefore, it may be necessary to interchange the interface boards in one of the two DV-MUX3 units connected in the link.

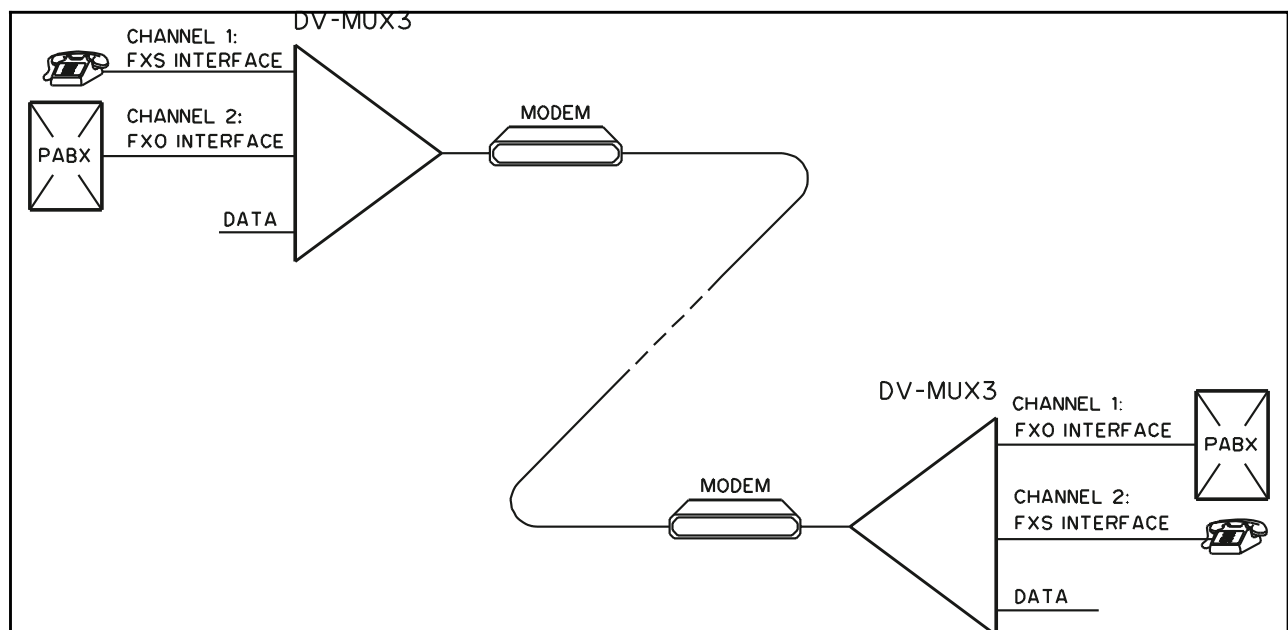


Figure B-1. Typical Application for DV-MUX3 with MIX Option

B-2. INTERCHANGE OF INTERFACE BOARDS

WARNING

Before carrying out the following procedure, read carefully the WARNING and CAUTION appearing on page 2-3 of this manual.

Interface Board Interchange

- Open DV-MUX3 case in accordance with the instructions appearing in the *Opening DV-MUX3 Case* section in para. 2-4.
- Refer to figure B-2 and identify the interface boards.
- Release the screws fastening the two boards.
- Remove the boards and interchange their positions.
- Close DV-MUX3 case in accordance with the instructions appearing in the *Opening DV-MUX3 Case* section in para. 2-4.

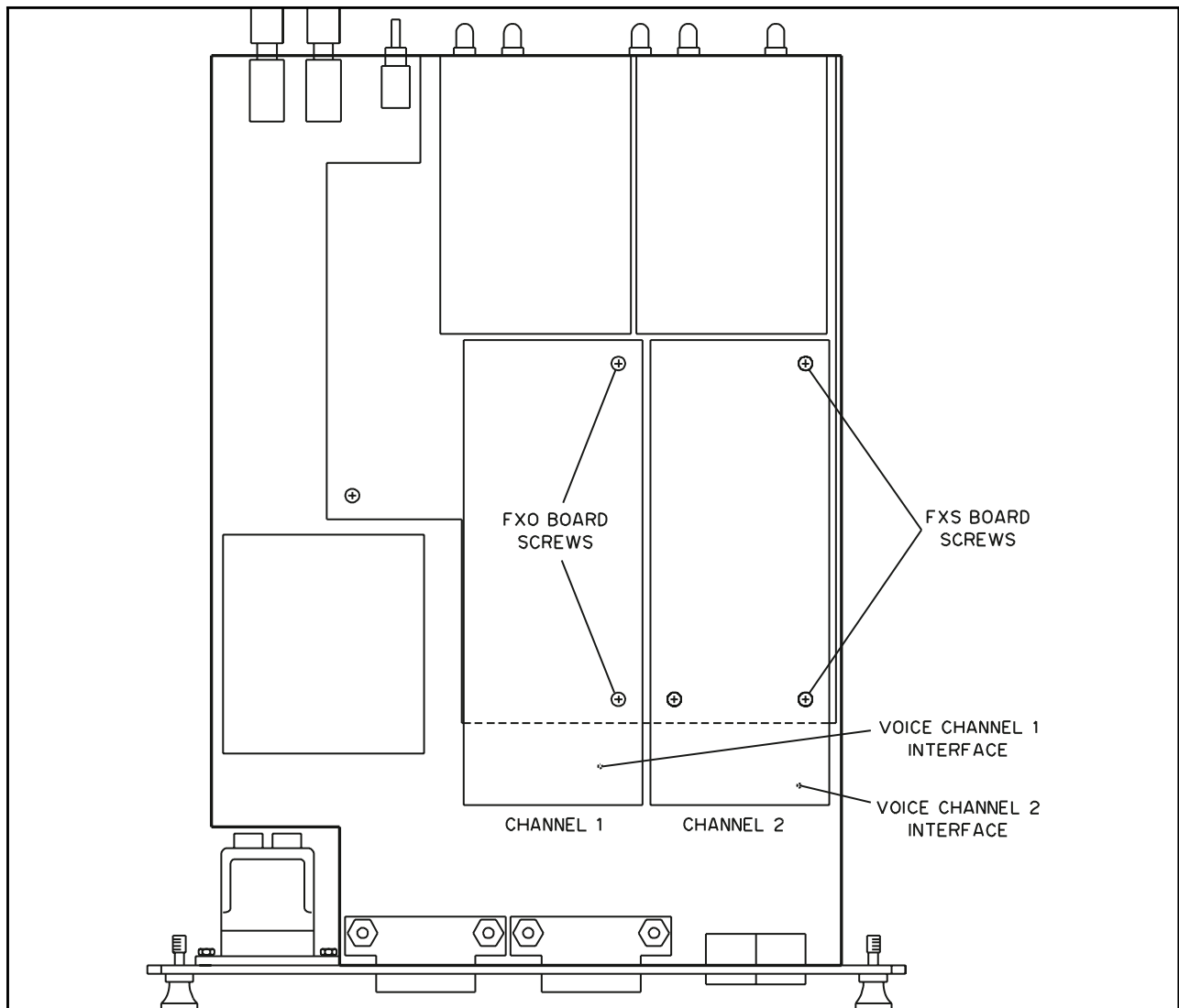


Figure B-2. Board Identification

APPENDIX C.

RACK INSTALLATION

Contents	Page
General	C-1
Installation of Single DV-MUX3 Unit	C-2
Installation of Two DV-MUX3 Units	C-3

C-1. GENERAL

The DV-MUX3 can be installed in 19" racks. Unit height corresponds to 1U (1.75"), and the width is slightly less than half of the available mounting width. Two rack adapter kits are available; one kit provides the hardware necessary for installation of a single unit, and the other provides the hardware necessary for installation of two units, side by side.

This Appendix provides step-by-step installation instructions for each option.



Disconnect all the cables from the units, and then disconnect the units from power while performing the following procedures.

Always observe standard safety precautions during installation, operation, and maintenance of this product.

No internal settings, adjustment, maintenance, and repairs may be performed by either the operator or the user; such activities may be performed only by a skilled technician who is aware of the hazards involved.

C-2. INSTALLATION OF SINGLE DV-MUX3 UNIT

The rack adapter kit includes one short bracket and one long bracket. The brackets are fastened by means of screws to the two side walls of the case, as shown in figure C-1.

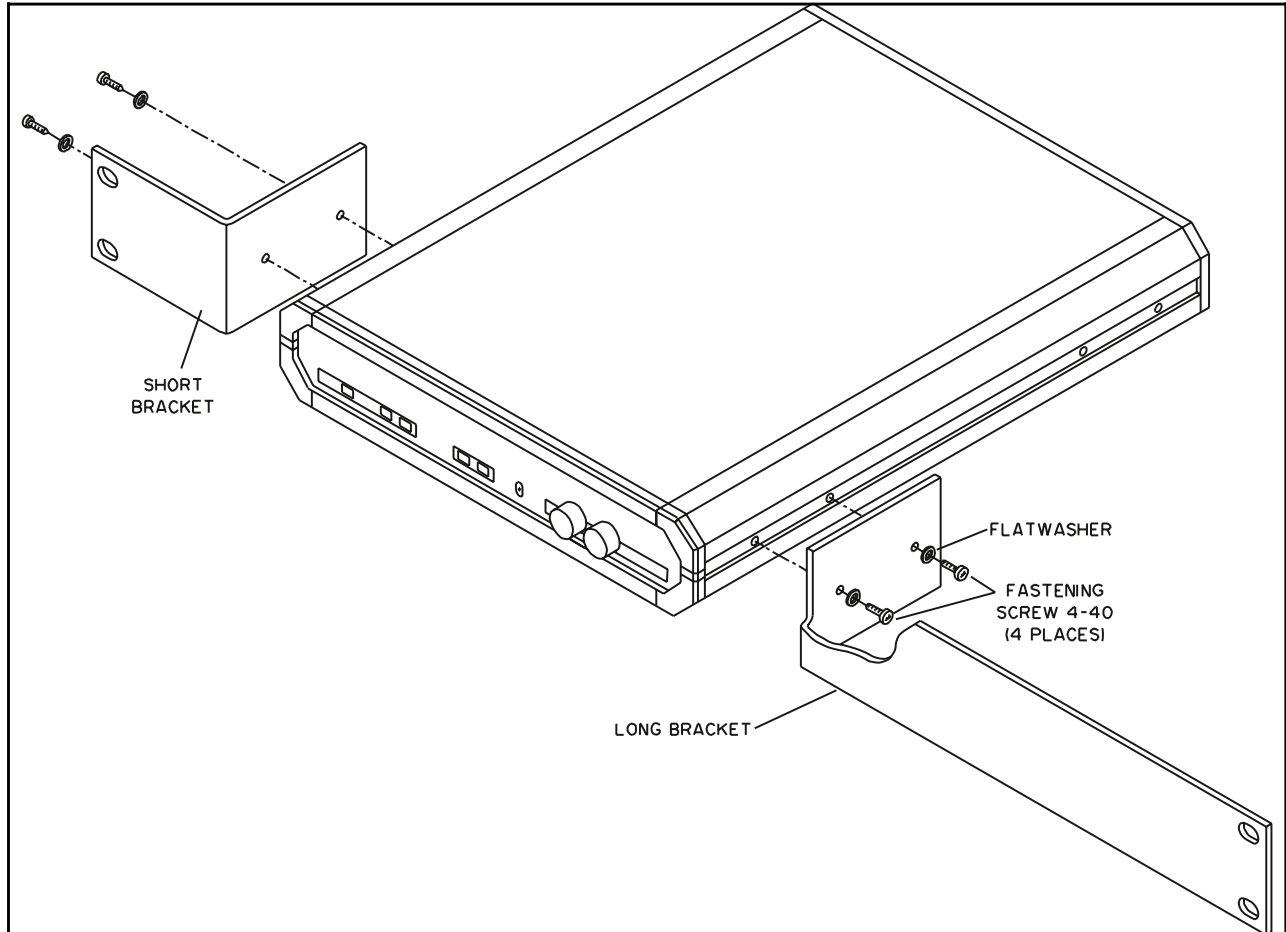


Figure C-1. Installation of Single DV-MUX3 Unit in 19" Rack

To prepare the unit for rack installation:

- Attach the two brackets to the side walls of the unit. Each bracket is fastened by means of two screws (with flat washers), which are inserted into the two front holes on the side wall (nuts are already in place, on the inner side of the wall).
- After attaching the brackets, the unit is ready for installation in the 19" rack. To install in the rack, fasten the brackets to the side rails of the 19" rack by means of four screws (not included in the kit), two each side.

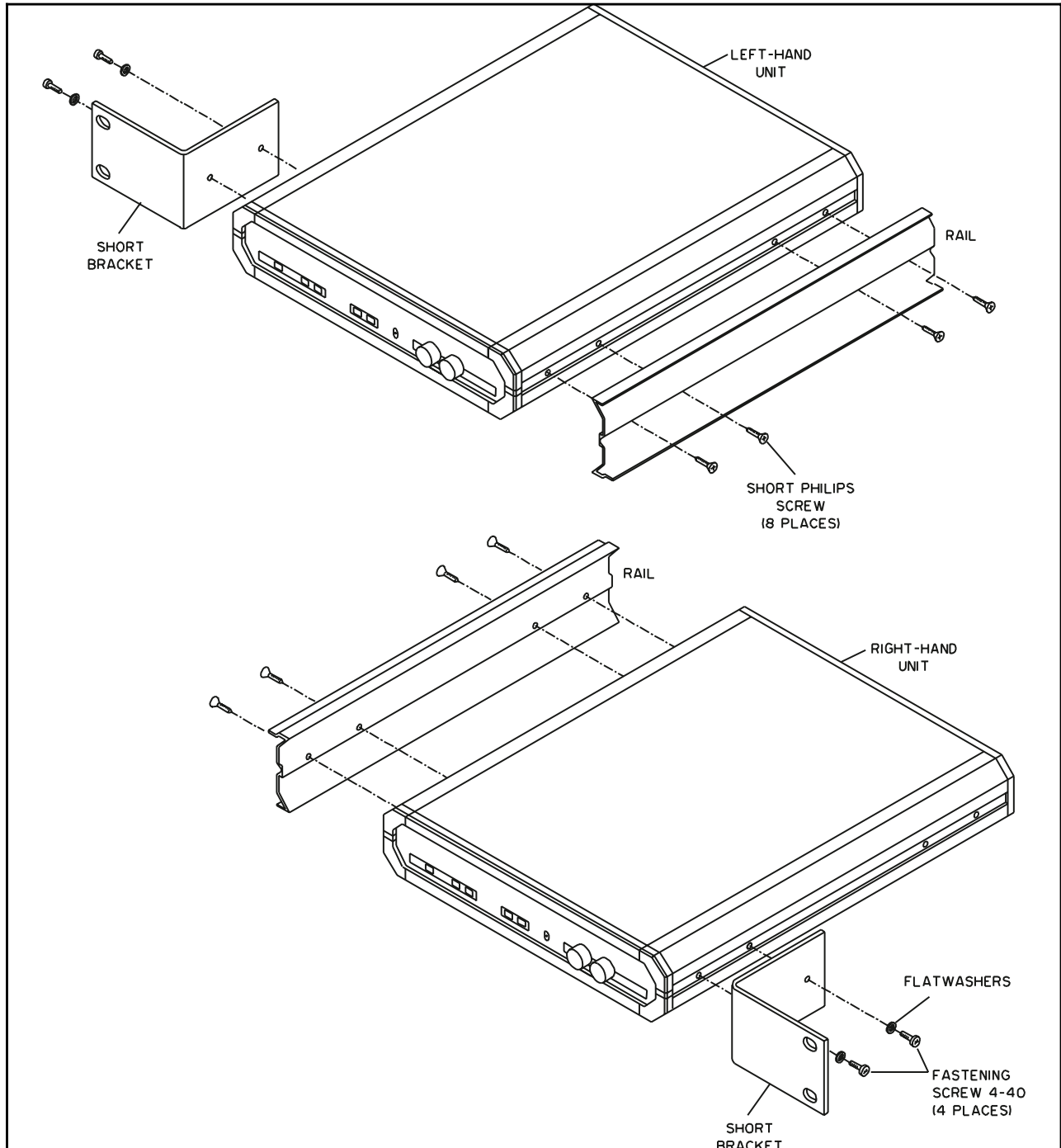
C-3. INSTALLATION OF TWO DV-MUX3 UNITS

General

The rack adapter kit includes two rails for attaching the two units side by side, two short adapter brackets, and various hardware.

Preparations

Refer to figure C-2 and prepare the two DV-MUX3 units for attachment as fol-



lows:

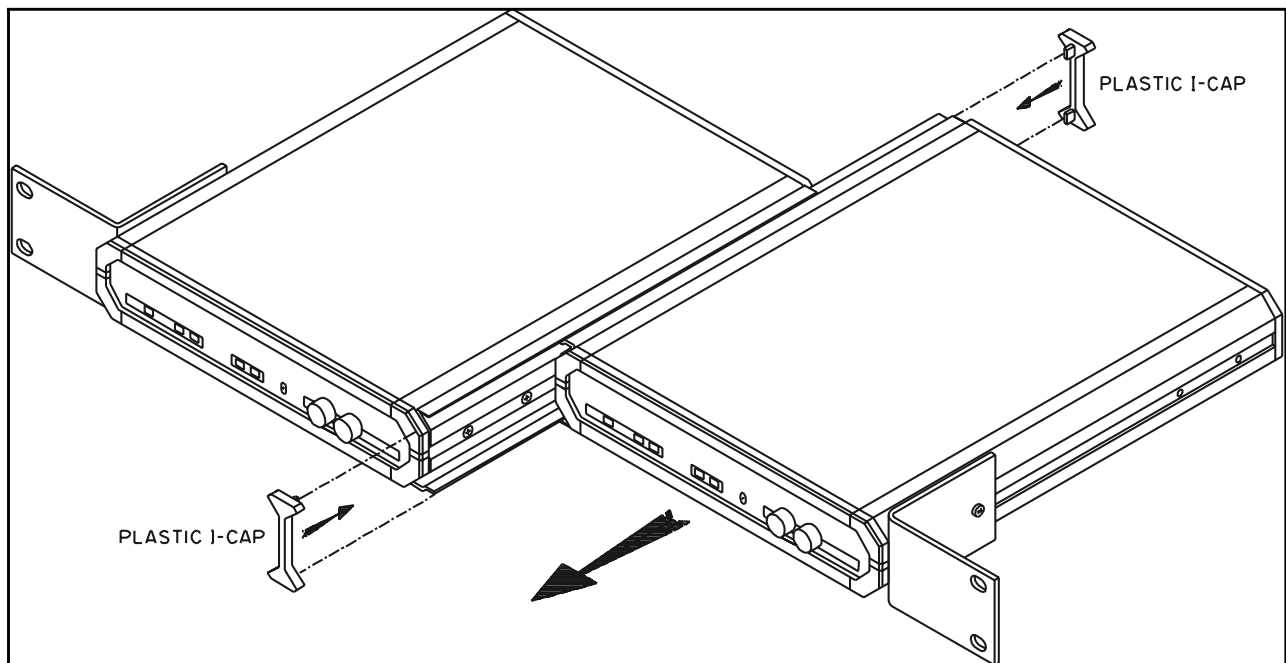
Figure C-2. Preparation of Two DV-MUX3 Units for Installation in 19" Rack

- Fasten one short adapter bracket to the left-hand side wall of the unit intended to be on the left. Use two of the four longer screws supplied in the kit, and insert flat washers.
- Use the same procedure to fasten the second short adapter to the right-hand wall of the unit intended to be on the right.
- Position one of the two rails supplied in the kit on the right-hand wall of the unit intended to be on the left, and align its holes with the holes on the wall.
- Insert four short Philips screws and screw them through the rail into the holes on the unit wall.
- Use the same procedure to attach the second rail to the left-hand wall of the unit intended to be on the right. Make sure the wider rim of this rail is opposite the short rim of the other rail, as shown in figure C-2.

Fastening the Two Units

Refer to figure C-3 and attach the two units as follows:

- Position the ends of the rails attached to the two units so that the rails can slide one into the other, and then slide the units to bring the panels in line.



- Now insert plastic I-shaped caps between the two units, to cover the empty spaces left at the ends of the two rails.

Figure C-3. Attachment of Two DV-MUX3 Units Before Installation in 19" Rack

The assembled units can now be fastened to the side rails of the 19" rack by means of four screws (not included in the kit), two on each side.

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